UNIVERSIDADE DE SÃO PAULO
FACULDADE DE ODONTOLOGIA DE BAURU

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Facial profile assessment after oral rehabilitation with complete dentures through stereophotogrammetry

Avaliação do perfil facial após reabilitação oral com próteses totais utilizando Estereofotogrametria

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Tese constituída por artigo apresentada à Faculdade de Odontologia de Bauru da Universidade de São Paulo para obtenção do título de Doutor em Ciências no Programa de Ciências Odontológicas Aplicadas, na área de concentração Reabilitação Oral.

Orientadora: Profa. Dra. Simone Soares
Co-orientadora: Profa. Dra. Thais Marchini de Oliveira Valarelli

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ERRATA

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“O que prevemos raramente ocorre; o que menos esperamos geralmente acontece.”

Benjamin Disraeli

RESUMO

O colapso facial está associado ao edentulismo. Próteses totais convencionais (CCD) e próteses totais implantossuportadas (ISCD) restauram as proporções faciais à aparência natural. O conhecimento sobre este tópico pode fornecer novos parâmetros e métricas com base em dados abrangentes da face, uma vez que essas alterações faciais não são claras. Avaliar os efeitos estéticos faciais do tratamento de próteses totais através de uma análise 3D do terço inferior da face (superfície e volume) medidas lineares e angulares. Além disso, observar o colapso facial da perda dentária em comparação com um grupo controle e quantificar se os dois tipos de reabilitação (CCD e ISCD) podem restaurar as proporções faciais para corresponder às de um paciente dentado. A análise facial foi realizada por estereofotogrametria (3D) com o aparelho VECTRA H1. Medidas lineares, angulares e de superfície foram analisadas na face. A amostra foi composta por um mínimo de 28 pacientes por grupo divididos em grupo controle e os pacientes reabilitados com CCD e ISCD. A análise estatística foi realizada por teste t independente, teste t pareado e ANOVA um fator, de acordo com a situação analisada (α=0,05 para todas as análises). Os perfis faciais do grupo edêntulo com e sem prótese total apresentaram diferença estatística (P<.05) nas medidas lineares e angulares. Após quantificar o colapso facial comparando indivíduos edêntulos sem prótese total e o grupo dentado controle, os resultados mostraram que a maioria das diferenças ocorreu no terço médio e inferior da face, evidenciando encurtamento nessas áreas com diferenças nas medidas faciais em torno de 2 a 5 mm a menos no grupo desdentado. A comparação entre os dois tipos de reabilitação (CCD e ISCD) e os pacientes dentados mostrou várias diferenças. O ISCD não apresentou diferenças estatísticas com os dentados. A perda dentária afetou as proporções faciais no terço inferior da face. O fornecimento do CCD restaurou sua aparência facial, mas não exatamente as proporções faciais de indivíduos com dentição natural como o ISCD promoveu.

Palavras-chave: Prótese total. Fotogrametria. Face. Boca Edêntula.

ABSTRACT

Facial profile assessment after oral rehabilitation with complete dentures through stereophotogrammetry

Facial collapse is associated with edentulism. Conventional complete dentures (CCD) and implant-supported complete dentures (ISCD) restore facial proportions to the natural appearance. The knowledge about this topic could provide new parameters and metrics based on comprehensive data of the face once these facial changes are unclear. Evaluate the facial esthetic effects of complete dentures treatment through a 3D analysis of the lower third of the face (surface and volume) linear and angular measurements. Also, to assess the facial collapse from tooth loss compared with a control group and quantify whether the two types of rehabilitation (CCD and ISCD) can restore the facial proportions to match those of a dentate patient. The facial analysis was performed through stereophotogrammetry (3D) with the VECTRA H1 device. Linear, angular, and surface measurements were analyzed in the face. The sample was composed with a minimum of 28 patients per group into a control group and the rehabilitated patients with CCD and ISCD. The statistical analysis was performed by an independent t test, paired t-test, and one-way ANOVA, according to the situation analyzed ($\alpha=0.05$ for all analyses). The facial profiles of the edentulous group with and without complete dentures were statistically difference ($P<.05$) in linear and angular measurements. After quantifying the facial collapse by comparing edentulous individuals without complete dentures and the control dentate group, the results showed that the majority of differences occurred in the middle and lower third of the face, evidencing shortening in these areas with differences in facial measures of around 2 to 5 mm less in the edentulous group. The comparison among the two types of rehabilitation (CCD and ISCD) and the dentate patients showed several differences. The ISCD presented no statistical differences with the dentate people. Tooth loss affected the facial proportions in the lower third of the face. The provision of CCD restored their facial appearance but not precisely to the facial proportions of individuals with a natural dentition as the ISCD promoted.

Key words: Complete denture. Photogrammetry. Face. Mouth edentulous.

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LIST OF ABBREVIATIONS

TMD - Temporomandibular joint disorders

OVD - Occlusal vertical dimension

CCD – Conventional complete denture

ISCD – Implant supported complete denture

RMS – Root main square

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1 INTRODUCTION

Although the prevalence of edentulism has lessened over the last decade in developed countries, it is still considered a health problem in developing countries. [1-3] Tooth loss is still a significant disease in the elderly -population, remaining a challenge for dental professionals around the world.[1,3] It is more prevalent in women than in men.[4-5] According to the World Health Organization, edentulous patients are unable to chew properly and speak accurately.[6-7] This condition also may result in poor esthetics, which affects the quality of life and physical health.[1,8] Therefore, oral rehabilitation using complete dentures is required to address functional and aesthetic problems, including replacing teeth and restoring facial proportions. [9]

The most visible part of the human body is the face. Facial appearance is an individual perception that determines self-image and is a relevant concern for everybody.[10] Tooth loss interferes directly in the lower third of the face by reducing volume from the cheek, lips, and labial protrusion. Complete dentures can address this situation and restore the natural facial appearance. The lips should be supported correctly by the denture when normal muscle tone is reestablished [11-12] and the denture borders are formed adequately, as the labial flange, a typical characteristic in conventional mucosa-supported dentures.[13] The labial flange has been defined as “the proportion of the flange of a denture that occupies the labial vestibule of the mouth”.[14]

The provision of complete dentures, a procedure that has been compared with local plastic surgery[15] promotes masticatory function, phonetics, and esthetics, providing an acceptable facial profile.[16] The prostheses increase the occlusal vertical dimension (OVD) [17] and rehabilitate the lower face height. The goal is to restore facial proportions to each third of the face (upper, middle, and lower).[18-19]

Prosthetic treatment with different types of complete denture, a conventional complete denture (CCD) or implant-supported complete denture (ISCD), can restore masticatory function with artificial teeth and help maintain a natural facial appearance. The lower third of the face has a notable impact on the facial appearance. For complete denture wearers to retain a natural appearance[12,18] adequate lip support and an appropriate occlusal vertical dimension (OVD) must be provided.[20] Lip support with

complete dentures has been evaluated[19-21] but CCDs have a labial flange that is absent with ISCDs.[20].

The present research aimed to quantify facial collapse caused by tooth loss compared with a dentate patient and to quantify whether two different types of complete dentures can restore facial proportions similar those of the dentate population by stereophotogrammetry. The null hypothesis tested was that those rehabilitated with complete dentures, conventional or implant-supported, would show no differences from dentate individuals.

2 ARTICLES

2.1 ARTICLE 1

This manuscript was presented in this Dissertation written according to the European Journal of Prosthodontics and Restorative Dentistry instructions and guidelines for article submission.

3D evaluation with stereophotogrammetry of esthetic changes in the lower third of the face, labial protrusion, and lip after complete denture treatment

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ABSTRACT

Objectives: Evaluating the facial esthetic effects of complete denture (CD) treatment through a 3D analysis of the lower third of the face before (T1) and after (T2) the treatment by comparing and correlating measurements.

Methods: Thirty-one edentulous patients were enrolled. 3D images were captured before (T1) and after (T2) CD delivery. Twelve landmarks in the face were established. Linear, angular, surface, and perimeter measurements were evaluated at these times and compared with the paired t test. The delta (Δ) values (T2-T1) were assessed by the Spearman correlation to verify the associations between all measurements according to the facial parameters. Statistical tests were applied (5%).

Results: Statistical differences were identified in the lower third of the face in the linear measurement Sn-Gn ($p=0.006$), the angular measure Tright-Pg-Tleft ($p=0.004$), and at the surface of the lower third of the face ($p=0.001$). All measurements were statistically different in the labial protrusion area: the nasolabial angle (Prn-Sn-Ls), the surface, and the perimeter ($p=0.001$). In the lip evaluation, statistical differences were observed in the linear (Ls-Li), surface, and perimeter measurements ($p=0.001$).

Conclusion: The facial esthetic proportions of the linear surface and perimeter measurements increased, and the angles, sealed lips, nasolabial and lower facial convexity, decreased.

Keywords: Photogrammetry. Complete Denture. Face. Mouth Rehabilitation. Anatomic Landmarks. Lip.

INTRODUCTION

Although the prevalence of edentulism has lessened over the last decade in developed countries, it is still considered a health problem in developing countries.[1-3] Tooth loss is still a significant disease in the elderly - population, remaining a challenge for dental professionals around the world.[2,3] It is more prevalent in women than in men.[4,5] According to the World Health Organization, edentulous patients are unable to chew properly and speak accurately.[6,7] This condition also may result in poor esthetics, which affects the quality of life and physical health.[2,8] Therefore, oral rehabilitation using complete dentures is required to address functional and aesthetic problems, including replacing teeth and restoring facial proportions.[9]

In edentulous patients, different degrees of soft tissue facial collapse may occur. The visible consequences are shortening in the lower third of the face, deeper wrinkles, and drooping of the labial commissures.[10] Edentulism has been reported to result in individuals suffering from social and psychological problems because of an unsatisfactory facial appearance.[11,12] Replacement of the facial proportions with acceptable facial aesthetics is one of the crucial objectives in complete denture treatment.[13]

The most visible part of the human body is the face. Facial appearance is an individual perception that determines self-image and is a relevant concern for everybody.[14] Tooth loss interferes directly in the lower third of the face by reducing volume from the cheek, lips, and labial protrusion. Complete dentures can address this situation and restore the natural facial appearance. The lips should be supported correctly by the denture when normal muscle tone is reestablished [15,16] and the denture borders are formed adequately, as the labial flange, a typical characteristic in conventional mucosa-supported dentures.[10,17] The labial flange has been defined as “the proportion of the flange of a denture that occupies the labial vestibule of the mouth”.[18]

Currently, the prediction of facial changes depends mainly on subjective judgment and the dentist's experience rather than quantitative scientific analysis. Recently, changes in facial soft tissue after oral rehabilitation have been evaluated objectively,[10] but other studies focused only on patients' subjective satisfaction with their appearance after oral rehabilitation without objectively measuring facial changes.[19,20] Such changes can be measured with stereophotogrammetry, quantifying the facial proportions, and identifying the linear measurements and volume in the face.[13]

The three-dimensional (3D) surface imaging methods - digital stereophotogrammetry, surpassed two-dimensional (2D) photography, and is one of the most applied techniques in soft tissues studies. [21,22] The 3D face analysis lied on the combination of conventional and digital anthropometry. Conventional anthropometry identifies facial points and performs measurements using calipers, for example. Digital anthropometry captures the position

of specified landmarks and uses three coordinates for calculations based on Euclidean geometry: linear distances and angles.[23] The non-contact 3D surface capture method and non-invasive technique and non-invasive technique offer advantages such as direct measurements, quantification of angles, surface areas, volumes, in addition to linear distances, providing a wide variety of statistical analyzes.[24] A recent study showed the importance of a three-dimensional evaluation of facial aesthetics during oral rehabilitation planning, with the practical objective of determining the optimal solution for different clinical situations.[25,26]

Therefore, this study aimed to evaluate the effect of complete denture treatment through a three-dimensional (3D) analysis of the lower third of the face by quantifying the changes in facial proportions after the treatment according to the visually most modified areas of the labial protrusion and the lip and by comparing and correlating measurements. The null hypothesis tested was that no significant difference would be found before and after oral rehabilitation with complete dentures.

MATERIALS AND METHODS

After obtaining informed consent (Ethical approval protocol XXXXXXX), 31 participants (age range 50-85 years) were recruited for the present study. The sample size was calculated based on a previous study.[27] Considering a minimum relevant difference of at least 2.2 mm in the alteration of the soft tissues (standard deviation, 3.98 mm) as previously evaluated in the studied population, adopting a significance of 0.05, and test power of 0.80, the sample size obtained was at the minimum of 28 patients.

The inclusion criteria were edentulous patients who needed maxillary and mandibular complete dentures, having been completely edentulous for at least five and no more than 15 years with jaw relationship class I. Individuals with compromised neuromuscular control, unfavorable ridge relationships, or temporomandibular joint disorders (TMD) (signs and symptoms of TMD, as clicking of the jaw, muscle spasms, limited mouth opening and facial pain) were excluded. This clinical and observational study was carried by an experienced prosthodontist and a dental laboratory technician by following the clinical steps of preliminary impressions, definitive impressions in custom trays, maxillo-mandibular relationship in centric relation and the occlusal vertical dimension (OVD) registered with the metric method,[28] mounting the casts in a semi-adjustable articulator, try-in appointment followed by anterior and posterior tooth arrangement, verification the occlusal vertical dimension (OVD) and occlusion relation, delivery of the complete dentures, and final patient approval of the functional and aesthetic aspects.

One calibrated operator conducted the image acquisitions by using the stereophotogrammetry device VECTRA H1 (Canfield Scientific, Inc.), which is described as a reliable method.[22] The participants had been instructed to remove earrings and to sit in a specific chair located to capture the images with a natural head position and to keep their lips closed, facial expression relaxed and eyes staring at a fixed point. A sequence of 12 anthropometric landmarks[29] Subnasale (Sn), Tragion (T), Alar curvature (Ac), Gnathion (Gn), Gonion (Go), Pronasale (Prn), Pogonion (Pg), Labiale superius (Ls), Cheilion (Ch), Crista philtri (Cph), Stomion (St), Labiale inferius (Li) in the lower third of the face (Table 1) were marked with an eyeliner by two previously calibrated examiners with the complete dentures inserted.

After the anthropometric landmarks had been marked, the participants were instructed to remove the complete dentures and keep their lips sealed for the first 3D capture T1 (before treatment), and, for the second image T2 (after treatment), the patients were instructed to maintain their lips sealed.

IMAGE ANALYSIS

The 3D face study was divided into three facial parameters: the lower third of the face, labial protrusion, and lips (Figure 1) through the linear (Sn-Gn; Ls-Li and perimeters of each region: the lower third of the face, labial protrusion, and lip), the angular (Tright-Pg-Tleft; Prn-Sn-Ls; Ls-St-Li), surface and volume measurements, and the differences (Δ = T2-T1) in all parameters (Table 1). The analysis was performed using the Vectra Analysis Module software program (VAM elaboration, Canfield Scientific Inc.).

The evaluation of the volume differences required superimposing the first with the second image (T2 and T1). This procedure requires accuracy by the system (VECTRA H1) and depends on the root mean square (RMS), which was checked in this study. In this case, to achieve precision with this method, the superimposition was determined by the non-change area on the face surrounded by the tragus points on both sides (right and left) and the glabella (G) (Figure 2 - A); the mean RMS of 0.20 was similar to the standard used previously.[22] An analysis of the different colors of the superimposition T1 and T2 of the face following the facial parameters (lower third face, labial protrusion, and lip) was used to determine the differences of volume and to illustrate the areas with significantly increased volume. The color green indicated superimposed areas; red indicated volume decrease, and blue indicated volume increased (Figure 2 - B, C, D). The perimeter and surface differences in each region were also assessed (Fig 2- E: the lower third of the face; F: labial protrusion, and G: lip).

MEASUREMENT ERROR

Interexaminer reproducibility was evaluated by the Cohen kappa test, k=0.78. The agreement between the two operators on the anthropometric landmarks (Sn; T; Ac; Gn; Go; Prn; Pg; Ls; Ch; Cph; St and Li) was considered substantial. Only one operator assessed the quantitative analysis and superimposition of the images, making all measurements twice at an interval of 15 days. The intraexaminer reproducibility was checked by the paired *t* test (systematic error) and Dahlberg[30] (random error) $p<.05$.

STATISTICAL ANALYSIS

The Shapiro-Wilk test was applied to verify the data distribution, the mean values at both times (T1 and T2) passed the normality test, and the comparison of before (T1) and after the rehabilitation treatment (T2) was evaluated by the paired *t* test. The delta (Δ) values did not pass the normality test, and the Spearman' correlation was used to verify the associations between the differences (Δ) in all measurements according to the facial parameters (lower third of the face, labial protrusion, and lip). All statistical analyses were performed with SPSS 25.0 software (IBM Corp, Chicago, USA) with a significance level of 0.05 and a test power of 0.80.

Table 1. Description of the morphometric points and abbreviations of the measurements relevant for analysis of the lower third face.

Anthropometric landmarks	Definition	Facial parameters	Measurements	Definition
Subnasal (Sn)	The midpoint of the angle at the columella base where the lower border of the nasal septum and the surface of the upper lip meet;		**Sn- Gn**	Distance between glabella and subnasal (mm)
Tragion (T)	The notch on the upper margin of the tragus (left and right);		**T**right-**Pg**-**T**left	Lower facial convexity (◦)
Alar curvature (Ac)	The most lateral point in the curved base line of each ala;	**Lower Third of the face**	**T**right-**Ac**right-**Sn**-**Ac**left-**T**left-**Go**left-**Gn**-**Go**right	Surface of the lower third face (mm^2)
Gnátio (Gn)	The lowest median landmark on the lower border of the mandible;		**T**right-**Ac**right-**Sn**-**Ac**left-**T**left-**Go**left-**Gn**-**Go**right	Perimeter Lower third face (mm)
Gonion (Go)	The apex of the maximum curvature of the mandible		**Δ Volume of Lower third face**	The volume of the difference between the superimposition of the lower third of the face (T2-T1) (cm^3)
Pronasale (Prn)	The most protruded point of the apex nasi;		**Prn- Sn-Ls**	Nasolabial Angle (◦)
Pogonion (Pg)	The most anterior point of the chin;		**Ac**right-**Sn**-**Ac**left-**Ch**left-**Pg**-**Ch**right	Surface of labial protrusion (mm^2)
Labiale superius (Ls)	The midpoint of the upper vermilion line;	**Labial Protrusion**	**Ac**right-**Sn**-**Ac**left-**Ch**left-**Pg**-**Ch**right	Perimeter of the labial protrusion (mm)
Cheilion (Ch)	The point located at each labial commissure (left and right);		**Δ Volume of labial Protrusion**	The volume of the difference between the superimposition of the area of the labial protrusion (T2-T1) (cm^3)
Crista philtri (Cph)	The point on each elevated margin of the philtrum just above the vermilion line (left and right);		**Ls-Li**	Height of the upper and lower vermilion (mm)
			Ls-St-Li	Sealed lips angle (◦)
Stomion (St)	The imaginary point at the crossing of the vertical facial midline and the horizontal labial fissure between gently closed lips;	**Lip**	**Ch**right-**Cph**right-**Ls**-**Cph**left-**Ch**left-**Li**	Surface of the lip (mm^2)
			Chright-**Cph**right-**Ls**-**Cph**left-**Ch**left-**Li**	Perimeter of the lip (mm)
Labiale inferius (Li)	The midpoint of the lower vermilion line;		**Δ Volume of the lip**	The volume of the difference between the superimposition of the lip area (T2-T1)

RESULTS

Thirty-one participants (5 men and 26 women) were evaluated for the present study, with a mean age of 67.6 ±8.7 years**.**

Linear, angular, surface, and perimeter measurements were compared before (T1) and after (T2) complete denture insertion (Table 2) with the paired *t* test. Statistical differences were detected in the lower third of the face in the linear measurement Sn-Gn (p=0.006), in the angular measurement Tright-Pg-Tleft (*P* = 0.004), and in the surface of the lower third of the face (p<.001). All measures were statistically different in the labial protrusion area: the nasolabial angle (Prn-Sn-Ls), the surface, and the perimeter (p<.001). In the lip evaluation, statistical differences were observed in the linear measurement (Ls-Li), surface, and perimeter (p<.001) but not in the sealed lip angle.

The Spearman correlation test was applied (Table 3) to verify the relations between the mean variation (Δ = T2-T1) measurements. The correlations identified volume differences between the labial protrusion and the lower third of the face, as the increased volume between these variables was significantly related (rho-Spearman=0.87/p<.001). Furthermore, the correlations between the lower third of the face and the lip had a positive association in the linear measurement Ls-Li with Sn-Gn (rho-Spearman=0.41/p=0.02) and lip surface with Sn-Gn (rho-Spearman=0.37/p=0.03) with increasing measurements, the same as the volume association between the lip and the lower third of the face (rho-Spearman= 0.78/p<.001). However, in the measurements Ls-Li with the angle Tright-Pg-Tleft (rho-Spearman=-0.52/p=0.002) and lip surface with the angle Tright-Pg-Tleft (rho-Spearman=-0.50/p=0.004), an inverse association was verified; as the measure Ls-Li increased, the lower facial convexity decreased.

Most correlations were between the labial protrusion and the lip and were inversely proportional. The nasolabial angle (Prn-Sn-Ls) was inversely related to the lip surface (rho-Spearman=-0.42/p=0.01) and volume (rho-Spearman=-0.38/p=0.03); the same occurred with the labial protrusion surface with the sealed lip angle (rho-Spearman=-0.37/p=0.04). However, the labial protrusion and lip surface (rho-Spearman=0.53/p=0.002) and the perimeter (rho-Spearman=0.71/p<.001) had a proportionally direct relationship. The perimeter assessment between the labial protrusion with the sealed lip angle was significant (rho-Spearman=-0.40/p=0.02) and inversely proportional. The association with the perimeter of the lip (rho-Spearman=0.64/p<.001) was directly proportional. The volume associations between the labial protrusion and the lip were significant (rho-Spearman=0.883/p<.001) and directly increased.

The relative proportions of surface and volume in percentages suggested that the labial protrusion and the lip impacted the lower third of the face, as described in Table 4.

Table 2. Comparison measurements before (T1) and after (T2) rehabilitation with complete denture (paired *t* test).

Facial parameters	Measurement	Before treatment (T1)	After treatment (T2)	Δ (T2-T1)	p≤0.05
Lower third of the face	**Sn- Gn (mm)**	64.59±4.87	66.25±5.23	1.66±3.15	**0.006***
	Tright-Pg-Tleft (◦)	64.02±2.62	63.38±2.03	-0.68±1.23	**0.004***
	Surface (mm^2)	158.04±17.02	164.36±14.10	6.32±7.04	**<0.001***
	Perimeter (mm)	589.98±25.95	591.53±25.16	1.55±4.68	0.075
Labial Protrusion	**Perimeter (mm)**	190.80±12.78	195.95±11.46	5.15±6.13	**<0.001***
	Surface (mm^2)	21.31±3.07	24.09±2.73	2.77±1.97	**<0.001***
	Prn-Sn-Ls (◦)	131.49±10.68	124.93±9.74	-6.55±5.71	**<0.001***
Lip	**Ls-Li (mm)**	8.22±2.72	10.70±2.15	2.48±2.12	**<0.001***
	Ls-st-Li (◦)	124.05±19.40	122.26±14.71	-1.79±16.11	0.54
	Surface (mm^2)	4.10±1.24	5.68±1.12	1.58±0.87	**<0.001***
	Perimeter (mm)	117.46±15.36	131.48±9.81	14.02±9.13	**<0.001***

* Statistically significant difference p≤0.05

Table 3. Spearman correlation between the Δ (T2-T1) in all measurements according to the division: Lower third of the face, labial protrusion, and lip.

Labial Protrusion	Lower Third of the face				
	ΔSn-Gn(mm)	**ΔTright-Pg-Tleft (◦)**	**Δsurface(mm²)**	**Δperimeter (mm)**	**Δvolume (cm³)**
ΔPrn-Sn-Ls	0.003	0.166	-0.321	0.181	-0.319
p value	0.988	0.372	0.078	0.329	0.080
Δsurface labial protrusion	0.138	-0.269	0.318	0.057	-0.118
p value	0.461	0.144	0.082	0.759	0.527
Δperimeter labial protrusion	0.014	-0.168	0.178	0.274	-0.244
p value	0.940	0.367	0.337	0.135	0.186
Δvolume labial protrusion	-0.201	-0.099	0.055	-0.176	**0.875****
p value	0.279	0.595	0.767	0.342	**<0.001**
Lip	**Lower Third of the face**				
	ΔSn-Gn(mm)	**ΔTright-Pg-Tleft (◦)**	**Δsurface (mm²)**	**Δperimeter (mm)**	**Δvolume (cm³)**
Δ Ls-Li	**0.410***	**-0.528****	-0.071	-0.342	0.010
p value	**0.022**	**0.002**	0.706	0.060	0.959
Δ Ls-St-Li	0.011	0.184	0.172	-0.128	0.287
p value	0.954	0.321	0.354	0.494	0.118
Δ Lip surface	**0.373***	**-0.504****	0.181	-0.123	-0.052
p value	**0.039**	**0.004**	0.331	0.510	0.781
Δ Lip perimeter	-0.085	-0.218	0.285	0.246	-0.009
p value	0.648	0.238	0.120	0.182	0.961
Δ Lip volume	-0.151	-0.117	0.072	-0.223	**0.782****
p value	0.416	0.530	0.699	0.228	**<0.001**
Labial Protrusion	**Lip**				
	ΔLs-Li(mm)	**ΔLs-St-Li (◦)**	**ΔSurface lip (mm²)**	**ΔPerimeter lip (mm)**	**ΔVolume lip (cm³)**
ΔPrn-Sn-Ls	-0.346	-0.071	**-0.421***	-0.115	**-0.388***
p value	0.057	0.704	**0.018**	0.539	**0.031**
Δ surface labial protrusion	0.321	**-0.371***	**0.536****	**0.712****	-0.113
p value	0.079	**0.040**	**0.002**	**<.001**	0.547
Δ Perimeter labial protrusion	0.126	**-0.404***	-0.205	**0.646****	-0.235
p value	0.499	**0.024**	0.267	**<.001**	0.204
Δ volume labial protrusion	0.059	0.345	-0.017	-0.002	**0.883****
p value	0.753	0.057	0.927	0.992	**<0.001**

**The correlation is significant at the 0.01/ *The correlation is significant at the 0.05

Table 4. Percentage relative to surface and volume of labial protrusion and lip in the lower third of the face after complete denture treatment.

	Lower third of the face Mean±SD	**Labial protrusion** Mean±SD	**Lip** Mean±SD	Other areas
Surface (mm^2)	6.32±7.04	2.77±1.97	1.58±0.87	-
	100%	**43.91%**	**25%**	31.09%
Volume (cm^3)	14.93±7.73	6.07±2.35	1.53±0.64	-
	100%	**40.68%**	**10.30%**	49.02%

DISCUSSION

The present study evaluated the effect of complete denture treatment in 31 patients through a 3D analysis of the lower third of the face, quantifying the changes in facial proportions after the treatment. The null hypothesis was rejected as differences were observed in the lower third of the face, labial protrusion, and lip.

Although facial changes are evident in edentulous people, and treatment with complete dentures restores facial proportions, few studies have quantified these conditions.[8,11] The use of stereophotogrammetry facilitates these analyses as it is capable of assessing linear measures and quantifying surface and volume with precision.[22,31-34]

THE LOWER THIRD OF THE FACE

As expected, significant differences were found in the third lower of the face. The rehabilitation increased the occlusal vertical dimension (OVD) as reported in other studies.[10,31,35] Sterenborg et al.[33] reported an exponential increase in the OVD being associated with increased lower facial height, as observed in the present study.

Yuan et al.[10] reported that changes after rehabilitation do not occur in the entire lower third of the face, despite the considerable changes seen in the lower facial height. Only 10 participants, ranging from 68-80 years old, were enrolled in their study. In the present study, 31 participants from 50-85 years were evaluated. Other alterations in the face were observed, including TR-Pg-TL, which represents the lower facial convexity. In the present study, an inverse relation was revealed. As the OVD increased, the lower facial convexity diminished, consistent with Yuan et al.[10] statement that facial changes occur after rehabilitation.

Sterenborg et al.[33] evaluated changes in OVD from 0, rest, 1mm, 3mm, and 5mm in patients with a mean age of 25 ±3 years. They reported mean values from 63.9 mm, 65.6 mm, 67.1 mm, 69.1 mm, and 70,6 mm, respectively. In the present investigation, values were observed to be 64.59 before and 66.25 after (centric relation position) complete denture insertion. However, Sterenborg et al.[35] evaluated a much younger population and, through multiple regression analysis, verified a significant positive correlation between the increase of the OVD and the lower face height, increasing 1 mm in OVD, resulting in 1.05 mm in the stereophotogrammetry

measurements. The present study did not evaluate different OVD values, only assessing it before and after complete denture placement.

Only one study[11] evaluated edentulous patients before and after rehabilitation by using stereophotogrammetry. They reported a mean increase in the OVD of approximately 2 mm, similar to the present investigation.

The stereophotogrammetry measurements presented significant differences, showing fuller cheeks, lips with increased volume, and an improved smile, changes that should enhance quality of life. Tang et al.[13] superimposed images and observed surface increase but did not quantify the values.

LABIAL PROTRUSION

During the making of a complete denture, it is possible to lengthen the lower third of the face and to reduce wrinkles and drooping of the labial commissures. As the nasolabial angle decreases, the surface labial protrusion increases in a direct relationship. The procedure depends on professional experience, observation of the patient's profile, and accurate recording of the maxillary-mandibular relationship.[36,37]

The nasolabial angle observed in Brazilian, Chinese, and European individuals declined by approximately 7 degrees from before and after delivery of the complete denture.[13,38] However, the Tartaglia et al.[38] study involved implant-supported prostheses.The nasolabial angle and labial protrusion are influenced by the position of the anterior teeth[36,39] and the labial flange,[40,41] although Bidra et al. concluded that the flange in the maxillary denture resulted in a clinically insignificant difference in lip support.[25] The present investigation did not compare flanged and flangeless dentures; however, complete dentures with a flange diminished the nasolabial angle proportionally with an increase in labial protrusion ($p<0.001$). The present research did not quantify alveolar bone resorption as participants with atrophic arches [11] and with long-term edentulism (+5 years) were enrolled. Bidra et al did not determine differences in facial proportions after rehabilitation in patients with more than 5 years of edentulism.[26]

LIPS

Labial augmentation is an objective to be achieved in all procedures involving facial aesthetic treatment. Studies that analyzed the three-dimensional structure of the lip are lacking. The present study determined that complete denture treatment increased the labial height (2.5 mm), labial surface (1.58 mm^2), and perimeter (14.02 mm), providing labial augmentation.

A comparison of the total vermillion lip height (Ls-Li) was not possible because the available studies analyzed young adults[42,43] and non-Caucasian individuals.[44] The present investigation evaluated Caucasian individuals aging from 50-85 years old. However, Sawyer et al. found that the total lip area in young adults was

divided into the upper lip (2.6 mm) and lower lip (2.5 mm),[42] resulting in a sum 5.1 mm compared with 5.68 mm in the present study after complete denture treatment. The authors are unaware of previous studies that correlated facial change measurements (Δ=T2-T1) after complete denture treatment.

CORRELATIONS IN FACIAL MEASUREMENTS AFTER REHABILITATION

LOWER THIRD OF FACE AND LABIAL PROTRUSION

The correlation evaluated showed a significant direct relationship in volume (r=0.875/p=<.001). With volume increase in the lower third of the face, labial protrusion also increased. This association was expected because the CD directly influences labial protrusion.

LOWER THIRD OF FACE AND LIP

A significant association was found between the OVD (OVD – Sn-Gn) and the total vermillion height (r=0.41/p=0.02) and the OVD and the surface of the lip (r=0.37/p=0.03). When the OVD was increased, the vermillion height and labial surface also increased.

In the frontal plane, an inverse relationship was observed in the lower facial convexity (Tright-Pg-Tleft). As the total vermillion height (Ls-Li) and lip surface increased, the lower facial convexity diminished. As the volume of the lower third of the face increased, the volume of the lip increased in a direct relationship.

LIP AND LABIAL PROTRUSION

An inverse relationship was found between Δ surface labial protrusion (r=-0.371/p=0.040) and Δ perimeter labial protrusion (r=-0.404/p=0.024). Therefore, as the surface and perimeter are increased, the sealed lips angle diminishes (Ls-St-Li). The same inverse relationship was observed between the nasolabial angle (Prn-Sn-Ls) and the Δ surface lip (r=-0.421/p=0.018) and between the nasolabial angle, the Prn-Sn-Ls and the Δ volume lip (r=-0.388/p=0.031).

Correlating Δ surface labial protrusion and Δ surface lip, a direct relationship was found. As the surface labial protrusion increased, the lip surface also increased. In addition, a direct correlation was observed between Δ perimeter lip and Δ surface labial protrusion (r=0.712/p<.001) and between Δ perimeter lip and Δ perimeter labial protrusion (r=0.646/p<.001). Finally, a direct correlation was found between Δ labial protrusion volume (r=0.883/p<.001) and Δ lip volume. As the labial protrusion volume increased, the lip volume also increased.

The present investigation evaluated the labial protrusion and lip (%) and determined how much these values can represent in the surface area (mm^2) and volume (cm^3) of the lower third of the face. These values

presented 43.91% and 40.68% for labial protrusion and 25% and 10.30%, lip, respectively. The other areas presented in surface 31.09% and 49.02% in volume.

CONCLUSION

After complete dentures were delivered, the vertical lower third inferior of the face, the height of the upper and lower lip vermilion, surface and perimeter measurements increased in facial proportions. However, the angles of the sealed lips, nasolabial and lower facial convexity decreased. The volume of the labial protrusion, and the lip volume increased.

As the OVD rises, the lip height and lip surface also rise, proportionally.An inverse relationship was observed in the lower third of the face and the lip. As the lip surface and the lip height increased, the facial convexity angle decreased. The equivalent relation between the lip and the labial protrusion also was observed. As surface and volume lip increase the nasolabial angle decrease. As the perimeter and surface of the labial protrusion increased as the angle of the sealed lip diminished.

Clinical implications: A comprehensive study of the edentulous patient's face and how oral rehabilitation with complete dentures modify the facial esthetics proportions could provide new parameters to the clinician. Quantifying facial measurements through stereophotogrammetry is a reliable method to verify facial esthetic changes that contribute to evaluating the facial proportions established by prostheses.

DECLARATIONS

Conflict of interest

The authors have stated that there are no conflicts of interest in connection with this article.

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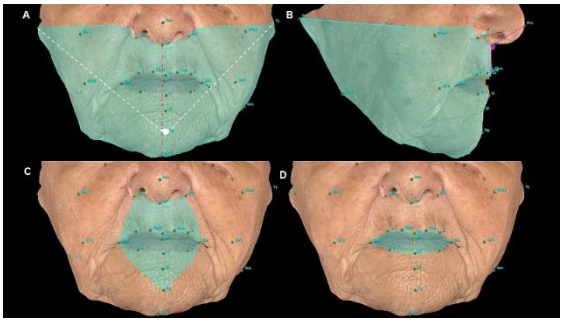

Figure 1: A- Frontal view of the delimitated surface and perimeter of the lower third of the face by morphometric points: **T**right-**Ac**right-**Sn**-**Ac**left-**T**left-**Go**left-**Gn**-**Go**right/ The linear measurement of the occlusal vertical dimension marked by the red straight line (**Sn-Gn**) and the angular measurement of the lower facial convexity marked in black (**T**right-**Pg**-**T**left). **B-**Sagittal view of the surface and perimeter of the lower third of the face/ The measurement of nasolabial angle marked in pink (**Prn**-**Sn**-**Ls**) and the sealed lips angle (**Ls**-**St**-**Li**) marked in orange. **C-** The delimited surface and perimeter of the labial protrusion surrounded by the morphometric points: **Ac**right-**Sn**-**Ac**left-**Ch**left-**Pg**-**Ch**right and the red line (**Ls-Li**) the liner measurement of the lip height. **D-** The delimited surface and perimeter of the lip by the morphometric points: **Ch**right-**Cph**right-**Ls**-**Cph**left-**Ch**left-**Li.**

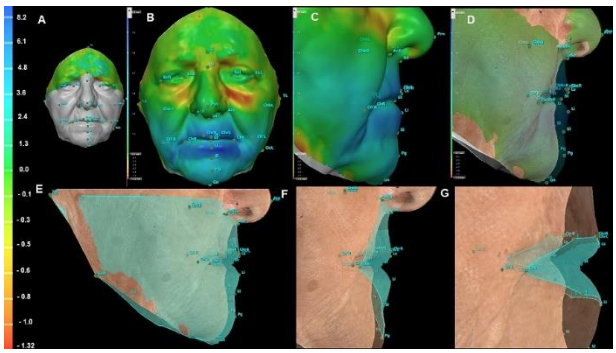

Figure 2: A- Superimposition T1 and T2 of the non-change area to proof accuracy and certificate the RMS (root mean square). **B-** Elaboration of a chromatic facial analysis with different colors of the superimposition T1 and T2 of the face, selecting the lower third face (green, superimposed areas; red and blue, discordant areas between the 2 scans). **C-** Sagittal view of the labial protrusion. **D-** Sagittal view of the difference superimposition, blue areas increased mean 5.19mm T2 of T1. **E-** Sagittal view of the surface of the lower third face differences T2 to T1 and **E-** Labial protrusion and **F-** the lip.

2.2 ARTICLE 2

This manuscript was presented in this Dissertation written according to the Journal of Prosthetic Dentistry (JPD) instructions and guidelines for article submission.

Quantifying the facial proportions in edentulous individuals before and after rehabilitation with complete dentures compared with dentate individuals: a 3D stereophotogrammetry study

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ABSTRACT

Statement of problem. Facial collapse is associated with edentulism, and, while the provision of complete dentures promotes masticatory function and esthetics, whether complete dentures restore facial proportions to the natural appearance found in dental individuals is unclear.

Purpose. The purpose of this clinical study was to assess the facial profiles of edentulous individuals before and after treatment with complete dentures and compare these profiles with those of dentate individuals matched by age as the control.

Material and methods. Sixty White participants were recruited as 2 groups: 30 edentulous participants provided with complete dentures in both arches and 30 participants with natural teeth and normal occlusion. Facial analysis was performed through 3D stereophotogrammetry. Linear, angular, surface, and perimeter facial measurements were made and statistically analyzed with paired and independent *t* tests (α=.05).

Results. The mean age ±standard deviation was 63.16 ±7.33 years for the edentulous participants and 60.43 ±5.34 for the dentate controls, without statistical differences between ages (P=.105). The facial profiles of the edentulous group with and without complete dentures were statistically difference (P<.05) in 6 linear and 5 angular measurements. After quantifying the facial collapse by comparing edentulous individuals without complete dentures and the control dentate group, the results showed that the majority of differences occurred in the middle and lower third of the face, evidencing shortening in these areas with differences in facial measures of around 2 to 5 mm less in the edentulous group. However, statistically significance differences between the participants with complete dentures and the control dentate group, were

found in only 2 linear measurements (the distance between the right and the left exocanthion to cheilion), in the sealed lip angle and the left gonial angle, and in the surface and perimeter ($P<.05$).

Conclusions. Tooth loss affected the facial proportions in the lower third of the face. The provision of complete dentures restored their facial appearance but not precisely to the facial proportions of individuals with a natural dentition, as considerable differences were detected in surface and perimeter measurements.

Key words: Complete denture, Photogrammetry, Face, Mouth edentulous

CLINICAL IMPLICATIONS

Traditionally, empirical methods have been used to assess the esthetic outcome of complete denture treatment, with optimal esthetics depending on the ability and experience of the clinician. Improved assessment of facial proportions can be made with stereophotogrammetry technology, establishing new parameters and metrics based on comprehensive data of the face and providing a comprehensive evaluation of the impact of complete dentures on facial proportions.

INTRODUCTION

The aging process leads to changes in the skin, soft tissue, and skeleton of the face,[1] with progressive bone resorption and decreased tissue elasticity.[2,3] This process may be more pronounced in edentulous individuals, and an unsatisfactory facial appearance may be associated with social and psychological problems.[4,5] Tooth loss contributes to an aged facial appearance induced by reduced fibrous connective tissue and decreased muscle activity.[6,7]

Edentulous patients have reduced facial proportions subsequent to tooth loss, leading to different degrees of facial collapse and decreased residual alveolar bone height,[7] affecting facial

angles and proportions.[8,9] Edentulous individuals have been reported to have a shortening of the lower third of the face.[7,10,11]

Treatment for edentulous individuals should restore function by replacing missing teeth, but the restoration of facial appearance is also of great importance.[7,12] Edentulous patients are considered to be physically impaired, disabled, and handicapped by the World Health Organization criteria because of their inability to properly masticate and speak.[13]

The provision of complete dentures, a procedure that has been compared with local plastic surgery,[14] promotes masticatory function, phonetics, and esthetics, providing an acceptable facial profile.[7] The prostheses increase the occlusal vertical dimension (OVD)[15] and rehabilitate the lower face height. The goal is to restore facial proportions to each third of the face (upper, middle, and lower).[10,16]

Facial change has been evaluated by using stereophotogrammetry technology, [7,17-20] a noninvasive method with the advantages of rapid and accurate acquisition of data of great value for facial studies.[21] The facial proportions before and after the provision of complete dentures have been evaluated.[7,17,22,23] However, the authors are unaware of studies comparing edentulous individuals to an age-matched dentate control group to determine whether the treatment promotes a similar facial profile. The facial profiles of dentate and edentulous individuals have been compared[24,25]; however, these studies were limited because the groups were not matched by age and cephalometric records were used. These studies could not identify the facial change associated only with tooth loss because the natural aging process, which affects facial proportions, was not considered.

The present study aimed to compare the facial profiles before and after provision of complete dentures and to compare these profiles with a control group, individuals with the same mean age and an OVD determined by natural teeth. These evaluations should quantify the facial collapse related to tooth loss and assess whether the provision of complete dentures promotes

a facial profile similar to that of dentate individuals. The null hypothesis was that no differences in facial proportions would be found between the edentulous group with complete dentures and the control dentate group.

MATERIAL AND METHODS

This study was conducted after approval by the institutional review board. Written informed consent was obtained from all participants under protocol number CAAE: 99721718.6.0000.5417.

A total of 60 White participants were enrolled, 30 edentulous patients rehabilitated with complete dentures in both arches and the control group of 30 individuals with natural teeth and Angle class I occlusion. The sample size calculation was based on a previous study.[23] Considering a minimum relevant difference of at least 2.3 mm in the alteration of the soft tissues (standard deviation, 2.97 mm) as previously evaluated in the studied population, a significance of .05 and test power of .80 were adopted; the sample size obtained was 28 individuals. The inclusion criteria for the edentulous group were edentulous for at least 5 and no more than 15 years and provided with complete dentures in the institution where this study was conducted between 2019 and 2021 by an experienced prosthodontist (S.S.) and a single dental laboratory technician. Individuals with compromised neuromuscular control or temporomandibular joint disorders were excluded. The inclusion criteria for the control group were individuals who had an OVD established by natural teeth and Angle class I occlusion. Individuals who had received facial esthetic procedures, facial plastic surgery, or anterior fixed partial dentures were excluded.

The facial analysis was performed through 3D stereophotogrammetry (VECTRA H1; Canfield Scientific Inc). The participants were instructed to remove earrings and to sit in a specific chair located in a strategic location to capture the images with a natural head position.

They were instructed to keep the lips sealed, relax the facial expression, and keep the eyes open, looking at a fixed point. A sequence of 17 anthropometric landmarks[26] in the face (Table 1) were marked with an eyeliner (Make B; O Boticário) by 2 previously calibrated examiners (M.G.R.P. and G.H.L.T). For the edentulous group, the 3D facial analysis was done twice on the same day, with and without the complete dentures (Fig.1A, B). The participants were instructed to seal the lips lightly, during the imaging. The control group was recorded only once (Fig. 1C). The stereophotogrammetry was analyzed with a software program (Vectra Analysis Module; Canfield Scientific Inc) though linear (Fig. 2A), angular, (Fig. 2B) surface, and perimeter measurements (Fig. 2C and Table 2).

The superimposition of 3D images was analyzed to determine the changes in facial contour in the edentulous group after delivery. The root mean square (RMS) was 0.20 and considered accurate,[21] and the matched areas were those that had not changed, such as the forehead, surrounded by the TR- G- TL-Tr points. A chromatogram map was generated, representing nonchanged areas (in green), and decreased (in red) and increased (in blue) facial volumes (Fig. 3A and B, frontal and sagittal view).

The kappa coefficient was used to determine agreement between operators applying the anthropometric facial landmarks (0.81 for the analog landmarks and 0.84 for the digital landmarks).

The operators saved the landmarks on the system after calibration. One investigator (M.G.R.P.) made the quantitative (linear, angular, surface, and perimeter) analysis based on the defined anthropometric landmarks that had been previously saved.

The Shapiro-Wilk test was used to evaluate normality, and parametric (paired *t* test) and nonparametric (Wilcoxon) tests were used to compare the edentulous group before and after complete denture placement. The comparison between the edentulous group (with and without complete dentures) and the control group was evaluated by an independent *t* test (parametric)

and the Mann-Whitney test (nonparametric). All statistical analyses were performed with an open-source software program (Jamovi v.1.2; The Jamovi project) (α=.05, β=.08).

RESULTS

The 30 participants with complete dentures and the 30 dentate participants had mean ±standard deviation ages of 63.16 ±7.33 and 60.43 ±5.34, respectively, without statistical differences between ages (*P*=.105). The comparison between without dentures and with dentures showed statistically significant differences in 6 of the 13 linear distances evaluated, evidencing the facial collapse in the lower third of the face Sn-Gn (*P*<.001); N-Pg (*P*=.004); Sn-Pg (*P*<.001) and the proportions of the lips: Ls-Li; ChR-ChL; CphR-CphL (*P*<.001) without dentures. Statistically significant differences in the angular measurements were found for the nasolabial angle (Prn-Sn-Ls), with a decrease of approximately 6 degrees, and for the lower facial convexity, with an increase of 9 degrees (Sn-St-Pg) (Table 3).

The facial collapse in the edentulous group without dentures as compared with the control group is presented in Table 2. The results showed that the majority of differences occurred in the middle (N-Pg *P*=.016/ExR-Ch'R *P*=.005/ExL-Ch'L *P*=.004) and the lower third of the face (Sn-Gn *P*=.016/Sn-Pg *P*=.04/ChR-ChL *P*=.003/Ls-Li *P*<.001), quantifying the facial collapse subsequent to tooth loss, a reduction in linear measurements from 3 to 6 mm compared with the control group. In the angular measurements, statistical differences were found in 4 facial angles, 3 with larger values in edentulous individuals. The variation was from 2 degrees in the middle facial convexity (TR-Prn-TL) to the greatest angle change of 8 degrees in the nasolabial angle (Prn-Sn-Ls). However, the surface and the perimeter in the lower third of the face presented, in edentulous participants, smaller dimensions compared with those of the control group (Table 4).

The evaluation of edentulous participants with complete dentures compared with the control group demonstrated how the dentures affected facial proportions and determined whether the provision of dentures could restore the facial metrics to those of individuals with a natural dentition. Comparing the denture group with the control group, statistically significant differences were found in 2 linear measurements (ExR-Ch'R (*P*=.014)/ExL-Ch'L *P*=.019) in the middle third of the face, in the sealed lip angle (Ls-St-Li *P*=.014) and the left gonial angle (TL-GoL-Pg *P*=.019), and in the surface (*P*=.004) and the perimeter (*P*=.002) (Table 5).

DISCUSSION

Understanding the facial implications of tooth loss is a complex topic as 2 processes are involved, aging and the collapse of the lower third of the face. The facial collapse of edentulous patients has been studied and quantified,[7,17,23] mainly by using 3D imaging. The present study evaluated edentulous patients, with and without complete dentures, and age-matched dentate individuals by stereophotogrammetry. The changes observed led to rejection of the null hypothesis because significant statistical differences were found in linear, angular, surface, and perimeter measurements between the groups evaluated.

In the present study, the same patients were evaluated without (before) and with (after) their complete dentures, with obvious and notable differences in linear and angular measurements (Table 3). The comparison of the participants without and with dentures with the participants in the control group is presented in Tables 4 and 5 and revealed differences in linear, angular, surface, and perimeter measures.

Problems with facial esthetics have been studied[7,11,17] to create an appropriate smile and appearance that suits a patient's physical characteristics and esthetic needs, matching the natural facial appearance.[5] These problems have not been associated with temporomandibular disorders (TMDs) or the selection of the occlusal scheme of the complete denture.[6] However, how

complete dentures restore facial proportions is of considerable interest. The esthetics of the soft tissue support assumes the primary importance of facial contours,[10] and the complete dentures provide support for the lips[11] and cheeks.[10,12] Quantifying these changes through stereophotogrammetry helps give the natural appearance of dentate patients to edentulous patients.

The most relevant changes between individuals with and without complete dentures were observed in the lower third of the face. As expected, the OVD (Sn-Gn) increased (P<.001), consistent with Tang et al[7] and Toyoshima et al[23] The lower face height in patients without complete dentures compared with dentate patients presented statistically significant results (Sn-Gn: P=.014; N-Pg: P=.016, and Sn-Pg: P=.04), an expected finding since a stable occlusal relationship was an inclusion criterion in the control group. The soft tissues are supported by teeth as stated by Tang et al[7] and Sterenborg et al[27] evaluated the effect of complete rehabilitation, including an increase of OVD, in patients without tooth wear to detect differences in facial appearance, reporting statistically significant changes in facial appearance of the lower facial height (P<.05).

Because of tooth loss and subsequent soft tissue loss and a reduction of face height in the rest position, horizontal and vertical lip contour changes have previously been reported,[25] consistent with the findings of the present study. The edentulous and dentate participants had increased mouth width (horizontal dimension; ChR-ChL: 46.33 mm ±6.13; 51.2 mm ±6.21; P=.003) and height of upper and lower vermilion borders (vertical height; Ls-Li: 8.47 mm ±2.99; 11.30 mm±2.79; P<.001). The mouth width results were consistent with Sforza et al[19] who evaluated healthy dentate individuals of both sexes in 41-50, 51-64, 65-80 age groups and presented 53.9 mm±3.2 (male) 51.8 mm±2.9 (female), 55.5 mm±4.3 (male) 52.3 mm ±3.4 (female), 56.6 mm±5.8 (male) 50.2 mm±7.0 (female), respectively. On evaluating and comparing the height of the upper and lower vermilion border (Ls-Li) of the complete denture

patients and control group, the results for healthy patients were consistent with Sforza et al[19] in patients aged from 41-50, 51-64, 65-80. The results were 10.4 mm ±2.1 (male) and 13.2 mm ±1.4 (female), 10.9 mm ±1.9 (male) and 12.2 mm ±2.8 (female), 11.7 mm ±4.5 (male), and 10.4 mm ±2.5 (female), respectively. The heights of the upper and lower vermilion border (Ls-Li) were related to OVD, as reported by Ushijima et al[20] who concluded that the vermilion border height was affected by alterations in OVD. Increasing the OVD increased the Ls-Li values, as can be seen in patients without and with dentures (8.47 mm ±2.99 and 10.97 mm ±2.5, $P<.001$, respectively) and in participants without dentures and the control group (8.47 mm ±2.99 and 11.30 mm ±2.79, $P<.001$, respectively).

The mouth width (ChR-ChL) increased significantly (46.33 mm ±6.13 without dentures and 50.9 mm ±4.47 with dentures; $P<.001$), mainly because tooth loss contributed to the aged facial aspect induced by reduced fibrous connective tissue and decreased musculature activity.[6,7] The lip dimensions were increased in the vertical and horizontal dimensions, contrary to Tartaglia et al[17] who reported an increase in vertical and anteroposterior labial dimensions without a change to the mouth width.

The nasolabial angles (Prn-Sn-Ls) were reduced from without to with complete dentures ($P<.001$), and without dentures compared with the control group ($P=.012$). The angle reduction was because, as labial support increases, the nasolabial angle reduces, as reported by Kamashita et al[22], Tang et al[7] and Toyoshima et al[23] The optimal nasolabial angle for lip support is controversial. Watt and MacGregor[28] stated it to be approximately 90 degrees. Brunton and McCord[8] stated it to be about 110 degrees for White dentate individuals and to be an obtuse angle exceeding 90 degrees for edentulous patients when fabricating a complete denture. Owen et al[9] reported racial differences for the nasolabial angle in the facial appearance of the dentate group and that the nasolabial angle is a parameter of lip support.[22]

Lower facial convexity (Sn-St-Pg) increased (P<.001) when the complete denture was inserted, consistent with Toyoshima et al[23] (Table3). Comparing edentulous with the control group (Table 4), as expected, the angle increased (P=.001) and no statistically difference was observed evaluating patients with complete denture and control group (Table 5). The facial convexity (N-Sn-Pg) decreased, evidencing a more convex profile. An increased facial convexity leads to a smaller angle between N-Sn-Pg. Insertion of a complete denture improves the facial profile considerably, as seen with the increased values for TR-GoR-Pg and TL-GoL-Pg.

The distances between ExR-Ch'R and ExL-Ch'L in edentulous and dentate patients were 64.81 mm ±5.01 and 69.0 mm ±6.12, P=.005; 63.72 mm (55.1/81.2) and 69.1 mm (58.1/79.6), P=.004; respectively, confirming the increases in vertical dimension. The middle facial convexity (TR-Prn-TL) decreased when the edentulous participants were compared with the control group (66.38 mm±3.20 and 64.8 mm±2.59, P=.035, respectively)

The surface and perimeter increase in the lower third of the face when comparing the group without dentures and the control group and the group with dentures and the control group, indicating that the surface and perimeter cannot be restored to the values of the control group after complete denture delivery. These findings were contrary to those of Tang et al[7] who concluded that changes in a patient's facial esthetic characteristics were objectively revealed by comparing the patient's faces with Chinese people with a well-balanced profile. In the groups without and with dentures compared with the control group, no differences were observed in the surface or perimeter values.

Care must be exercised when evaluating the ExR-Ch'R and ExL-Ch'L in patients with complete dentures and the control group, since this measure is used as the rest vertical dimension to obtain occlusal vertical dimension in edentulous patients. The values were statistically significantly different, and whether using this measure to obtain the value for the

lower third of the face is correct is unclear. The facial collapse in edentulous patients was characterized quantitatively by a reduction of the linear measurements and an increase of the facial angles, except the lower facial convexity, even though the area and perimeter were smaller than those of the control group.

Limitations of the present study included the small sample size, the differences in sex distribution, (26 women, 4 men), and the cross-sectional study design. In addition, bone resorption was not quantified, although the sample consisted only of those edentulous between 5 and 15 years. Future longitudinal studies should follow the aging process and the differences associated with age and sex.

CONCLUSIONS

Based on the findings of this clinical study, the following conclusions were drawn:

1. Edentulism affected the facial proportions in the lower third of the face.
2. Provision of complete dentures restored the facial appearance in the horizontal and vertical dimensions, although not as in the natural dentition, with considerable differences in surface and perimeter.

TABLES

Table 1. List of anthropometric landmarks

Anthropometrics landmarks	Definition
Gnathion (Gn)	The lowest median landmark on the lower border of the mandible;
Cheilion (Ch)	The point located at each labial commissure (left and right);
Glabella (G)	The most prominent midline points between the eyebrows;
Crista philtri (Cph)	The point on each elevated margin of the philtrum just above the vermilion line (left and right);
Labiale superius (Ls)	The midpoint of the upper vermilion line;
Stomion (St)	The imaginary point at the crossing of the vertical facial midline and the horizontal labial fissure between gently closed lips;
Labiale inferius (Li)	The midpoint of the lower vermilion line;
Endocanthion (En)	The point at the inner commissure of the eye fissure (left and right);
Exocanthion (Ex)	The point at the outer commissure of the eye fissure (left and right);
Nasion (N)	The point in the midline of both the nasal root and the nasofrontal suture;
Pogonion (Pg)	The most anterior of the chin;
Pronasale (Prn)	The most protruded point of the apex nasi;
Subnasale (Sn)	The midpoint of the angle at the columella base where the lower border of the nasal septum and the surface of the upper lip meet;
Alare (Al)	The most lateral point on each alar (left and right);
Tragion (T)	The notch on the upper margin of the tragus (left and right);
Trichion (Tr)	The point on the hairline in the middle of forehead;
Alar curvature (Ac)	The most lateral point in the curved base line of each ala;

Table 2. List of abbreviations and definition of linear and angular measurements

Linear Measures	**Definition**
Tr – G	Upper third of the face;
G – Sn	Middle third of the face;
Sn – Gn	Lower third of the face;
N – Pg	Distance between nasion and pogonion;
Sn - Pg	Lower face height;
Ls - Li	Height of the upper and lower vermilion;
Sn - Ls	Height of the cutaneous upper lip;
Ex (R) - Ch (R')	Distance between exocanthion and cheilion' (right);
Ex (L) - Ch (L')	Distance between exocanthion and cheilion' (left);
Ac (R) – Ac (L)	The width between the alar curvature;
Al (R) – Al (L)	Nasal width;
ChR- ChL	Mouth width;
CphR - CphL	Width of the philtrum;
Angular Measures	**Definition**
Prn-Sn-Ls	Nasolabial angle;
Ls-St-Li	Sealed lips angle;
Sn-St-Pg	Lower facial convexity;
T(R) – Prn – T(L)	Middle facial convexity;
T(R) – Pg – T(L)	Lower facial convexity;
Go(R) – Pg - Go(L)	Mandibular convexity;
N–Sn–Pg	Facial convexity (excluding nose);
T(R)-Go(R)-Pg	Right gonial angle;
T(L)-Go(L)-Pg	Left gonial angle;
3D Measures	
Ac(L)-T(L)-Go(L)-Gn-Go(R)-T(R)-Ac(R)	Surface of the Lower third of the face
Ac(L)-T(L)-Go(L)-Gn-Go(R)-T(R)-Ac(R)	Perimeter of the Lower third of the face

Abbreviation: L: left side; R: right side.

Table 3. Comparison between edentulous patients without complete denture (**before)** and with complete denture (**after**) rehabilitation

Linear measures (mm)	**n=30**		***P***
	Edentulous/Without CD Mean ±SD (Median-ID.25%/75%)	**With CD Mean ±SD (Median-ID.25%/75%)**	
Tr-G	53.13 ±8.80	53.38 ±8.35	.30
G-Sn	61.46 ±4.71	61.2 ±4.97	.17
Sn-Gn	64.10 ±4.82	66.34 ±4.85	**<.001***
N-Pg	100.93 ±7.17	102.63 ±7.27	**.004***
Sn-Pg	51.80 ±5.23	53.62 ±5.50	**<.001***
Ls-Li	8.47 ±2.99	10.97 ±2.5	**<.001***
Sn-Ls	17.02(11.8/27.8)	17.2(12.2/27.8)	.22
ExR-Ch'R	64.81 ±5.01	65.4 ±4.89	.17
ExL-Ch'L	63.72(55.1/81.2)	64.35(56.7/83.5)	.30
ChR-ChL	46.33 ±6.13	50.9 ±4.47	**<.001***
CphR-CphL	11.25(5.62/17.9)	11.64(8.06/17.3)	**<.001***
AcR-AcL	36.08 ±3.20	36.45 ±3.47	.16
AlR-AlL	34.26 ±3.21	34.57 ±3.49	.09
Angular Measures (degrees)	**Edentulous/Without CD Mean ±SD (Median-ID.25%/75%)**	**With CD Mean ±SD (Median-ID.25%/75%)**	***P***
Prn-Sn-Ls	129.3 ±12.81	123.69 ±11.33	**<.001***
Ls-St-Li	127.32 ±18.54	125.32 ±16.72	.50
Sn-St-Pg	162.17(126/178)	171.31(156/179)	**<.001***
TR-Prn-TL	66.38 ±3.20	66.33 ±3.65	.84
TR-Pg-TL	63.43 ±2.28	63.2 ±2.02	.28
GoR-Pg-GoL (°)	76.64 ±4.59	76.6 ±4.69	.90
N-Sn-Pg (°)	172.57(145/179)	170.16(142/180)	**<.001***
TR-GoR-Pg	126.95 ±5.27	127.49 ±5.56	**.04***
TL-GoL-Pg	125.66 ±6.25	126.39 ±6.47	**.02***
Lower Third of the Face	**Edentulous/Without CD Mean ±SD (Median-ID.25%/75%)**	**With CD Mean ±SD (Median-ID.25%/75%)**	
Surface (mm^2)	158.8 ±15.54	161.49 ±15.70	.271
Perimeter	590.98 ±26.89	592.06 ±26.82	.153

ID, interquartile deviation; SD, standard deviation.
independent *t* test or Wilcoxon rank (nonparametric)
*statistically significant difference ($P<.05$)

Table 4. Comparison between edentulous patients **without complete dentures** and control group with normal facial parameters

Linear measures (13)	**N=30**	**N=30**	***P***
	Edentulous/Without CD Mean ±SD (Median-ID.25%/75%)	**Dentate/Control Group Mean ±SD (Median-ID.25%/75%)**	
Tr-G	53.13 ±8.80	57.1 ±10.85	.12
G-Sn	61.46 ±4.71	62.9 ±5.30	.25
Sn-Gn	64.10 ±4.82	67.8 ±6.25	**.014***
N-Pg	100.93 ±7.17	105.8 ±7.84	**.016***
Sn-Pg	51.80 ±5.23	54.6 ±5.36	**.04***
Ls-Li	8.47 ±2.99	11.30 ±2.79	**<.001***
Sn-Ls	17.07 ±3.27	18.2 ±3.38	.17
ExR-Ch'R	64.81 ±5.01	69.0 ±6.12	**.005***
ExL-Ch'L	63.72 (55.1/81.2)	69.1 (58.1/79.6)	**.004***
ChR-ChL	46.33 ±6.13	51.2 ±6.21	**.003***
CphR-CphL	11.25 (5.62/17.9)	11.5(8.27/16.1)	.29
AcR-AcL	36.08 ±3.20	35.10 ±3.96	.29
AlR-AlL	34.26 ±3.21	35.6 ±3.97	.14
Angular Measures (9)	**Edentulous/Without CD Mean ±SD (Median-ID.25%/75%)**	**Dentate/Control Group Mean ±SD (Median-ID.25%/75%)**	***P***
Prn-Sn-Ls	129.3 ±12.81	121.8 ±9.41	**.012***
Ls-St-Li	127.32 ±18.54	134.7 ±11.7	.069
Sn-St-Pg	161.48 ±12.37	170 ±6.34	**.001**
TR-Prn-TL	66.38 ±3.20	64.8 ±2.59	**.035***
TR-Pg-TL	63.43 ±2.28	62.30 ±2.73	.08
GoR-Pg-GoL	76.64 ±4.59	75.3 ±5.15	.28
N-Sn-Pg	172.57 (168.58/175.93)	167.9 (164.01/173.60)	**.013***
TR-GoR-Pg	126.95 ±5.27	125.64 ±5.21	.34
TL-GoL-Pg	125.66 ±6.25	122.8 ±5.03	.053
Lower Third of the Face	**Edentulous/Without CD Mean ±SD (Median-ID.25%/75%)**	**Dentate/Control Group Mean ±SD (Median-ID.25%/75%)**	***P***
Surface	155.63 (147.07/172.57)	168.1 (158.68/197.63)	**.002***
Perimeter	590.98 ±26.89	617.8 ±34.75	**.001**

ID, interquartile deviation; SD, standard deviation.
independent *t* test or Wilcoxon rank (nonparametric)
*statistically significant difference (*P*<.05)

Table 5. Comparison between edentulous patients **with complete dentures** and control group with normal facial parameters

Linear measures (13)	**N=30**	**N=30**	***P***
	With CD Mean ±SD (Median-ID.25%/75%)	**Dentate/Control Group Mean ±SD (Median-ID.25%/75%)**	
Tr-G	53.4 ±8.35	57.1 ±10.85	.14
G-Sn	61.2 ±4.97	62.9 ±5.30	.20
Sn-Gn	66.3 ±4.85	67.8 ±6.25	.33
N-Pg	102.6 ±7.27	105.8 ±7.84	.11
Sn-Pg	53.6 ±5.50	54.6 ±5.36	.47
Ls-Li	11 ±2.5	11.30 ±2.79	.63
Sn-Ls	17.2(3.19/12.2)	17.6(3.38/11.6)	.12
ExR-Ch'R	65.4 ±4.89	69.0 ±6.12	**.014***
ExL-Ch'L	64.3(56.7/83.5)	69.1(58.1/79.6)	**.019***
ChR-ChL	50.9 ±4.47	51.20 ±6.21	.83
CphR-CphL	11.9 ±1.73	11.8 ±2.03	.89
AcR-AcL	36.4 ±3.47	35.10 ±3.96	.16
AlR-AlL	34.6 ±3.49	35.6 ±9.97	.27
Angular Measures (9)	**With CD Mean ±SD (Median-ID.25%/75%)**	**Dentate/Control Group Mean ±SD (Median-ID.25%/75%)**	***P***
Prn-Sn-Ls	123.7 ±11.33	121.8 ±9.41	.47
Ls-St-Li	125.3 ±16.72	134.7 ±11.7	**.014***
Sn-St-Pg	169.1 ±7.58	170.5 ±6.34	.63
TR-Prn-TL	66.3 ±3.65	64.8 ±2.59	.059
TR-Pg-TL	63.2 ±2.02	62.30 ±2.73	.15
GoR-Pg-GoL	76.6 ±4.69	75.3 ±5.15	.29
N-Sn-Pg	170.2(154.68/177.00)	167.9 (1421/180)	.44
TR-GoR-Pg	127.5 ±5.56	125.64 ±5.21	.18
TL-GoL-Pg	126.4 ±6.47	122.8 ±5.03	**.019***
Lower Third of the Face	**With CD Mean ±SD (Median-ID.25%/75%)**	**Dentate/Control Group Mean ±SD (Median-ID.25%/75%)**	***P***
Surface	161.5 ±15.7	168.1 (158.68/197.63)	**.004***
Perimeter	592.1 ±26.82	617.75 ±34.74	**.002***

ID, interquartile deviation; SD, standard deviation.
independent *t* test or Wilcoxon rank (nonparametric)
*statistically significant difference (*P*<.05)

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Figure Legends

Figure 1. A- Edentulous face with complete denture installed in frontal and lateral view/B- Edentulous face without no treatment in the frontal and lateral view/C-Control group within frontal and lateral view.

Figure 2. A- Design of linear measurements evaluated/ B- Design of angular measurements evaluated/ C- The surface of the lower third of the face delimited.

Figure 3. A- Superimposition with and without complete denture (CD) by different colors measure in frontal view (green, superimposed areas; red and blue, discordant areas between the 2 scans).

Figures

Figure 1A

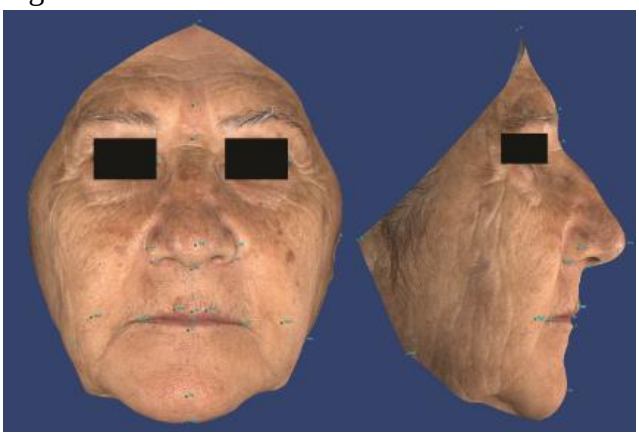


Figure 1B

Figure 1C

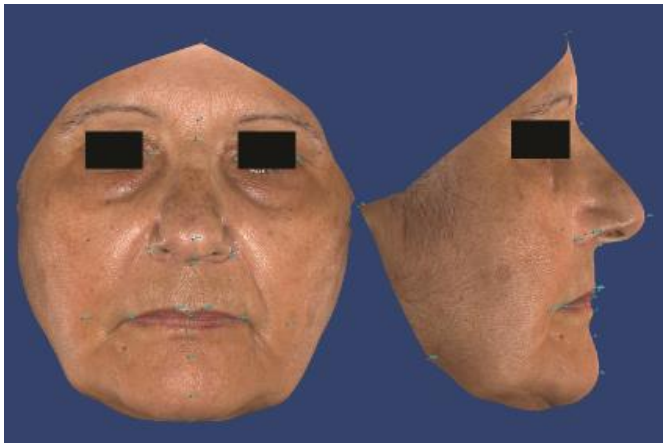


Figure 2A

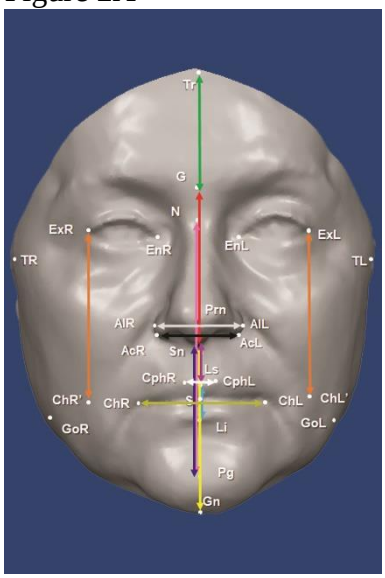


Figure 2B

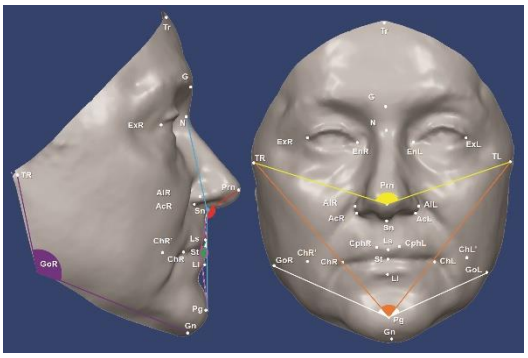


Figure 2C

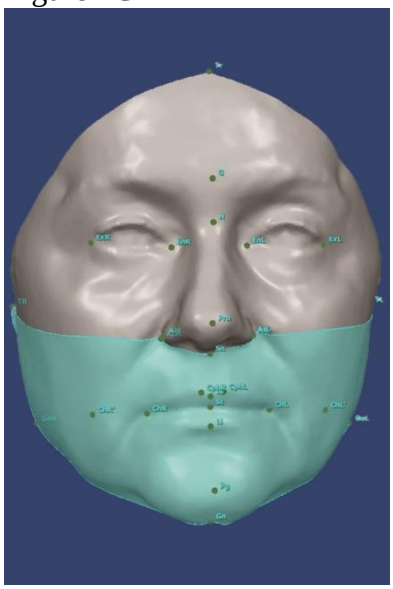


Figure 3A

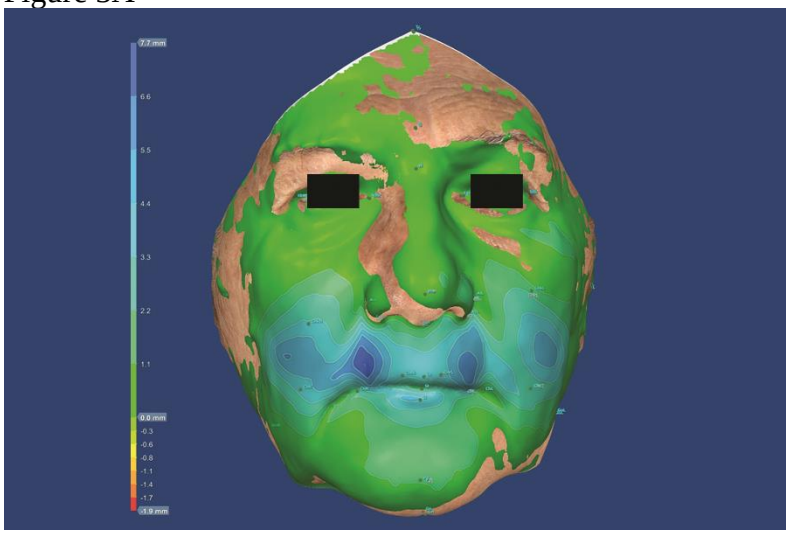
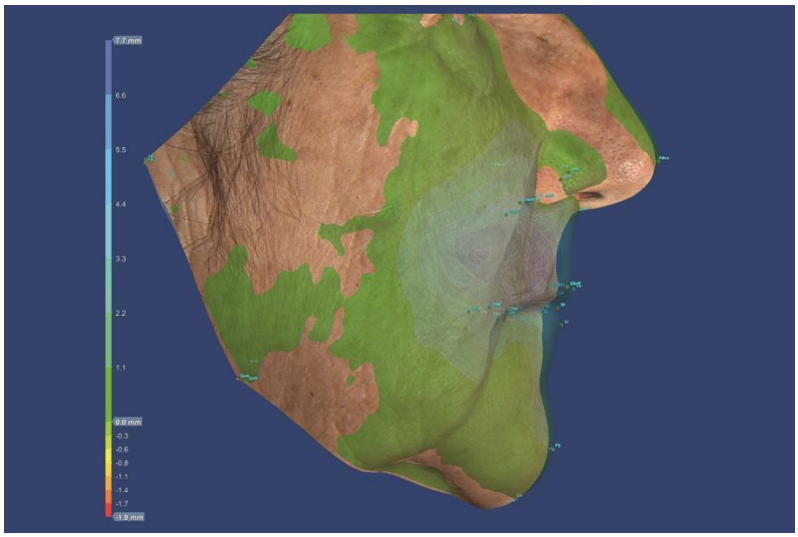


Figure 3 B



2.3 ARTICLE 3

This manuscript was presented in this Dissertation written according to the Journal of Oral Rehabilitation (JOR) instructions and guidelines for article submission.

Article type: clinical observational

Title: Facial metrics by stereophotogrammetry among individuals wearing a complete denture, implant-supported complete denture, and dentate individuals

Running title: Facial metrics postrehabilitation using stereophotogrammetry

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Abstract

Background: The changes in facial proportions in edentulous patients rehabilitated with conventional complete dentures (CCD) and implant-supported complete dentures (ISCD) could provide new parameters and metrics based on comprehensive data of the face.

Objective: To quantify the facial collapse from tooth loss compared with a control group and quantify whether the two types of rehabilitation (CCD and ISCD) can restore the facial proportions to match those of a dentate patient.

Methods: One hundred and four participants were enrolled and divided into edentulous (n=56) and dentate individuals (n=48) as the control group (CG). The edentulous participants had been rehabilitated with CCD (n=28) or ISCD (n=28) in both arches. The groups were compared among each other. The facial analysis was performed through stereophotogrammetry (3D) with the VECTRA H1 device. Linear, angular, and surface measurements were analyzed in the face. The statistical analysis was performed by an independent *t* test, and the one-way ANOVA (α=0.05 for all analyses).

Results: Facial collapse was quantified as a significant shortening of the lower third of the face in linear (Sn-Gn: p=0.02; N-Pg: p=0.03; Sn-Pg: 0.009; Ls-Li: p=<.001; CphR-CphL: p=0.0014; ExR-Ch'R; ExL-Ch'L; ChR-ChL: p=.001), angular (Prn-Sn-Ls: p=,.001; Sn-St-Pg: p=<.001; Tr-Prn-Tl: p=0.005; GoR-Pg-GoL: p=0.017; N-Sn-Pg: p=0.005), and surface (p=-0.002) and perimeter (p=0.032), affecting facial aesthetics. The comparison among the two types of rehabilitation (CCD and ISCD) and the CG showed differences in linear, angular, surface and perimeter. The CCD presented no statistical differences with the CG group in Sn-Gn, Sn-Pg and Ls-Li, and the ISCD showed more measurements similar to those in the CG, except for the TR-GoR-Pg angle.

Conclusion: The facial collapse in edentulous patients could be restored through oral rehabilitation with an ISCD.

KEYWORDS: computerized anthropometry, face, human, implant-supported prostheses

1 INTRODUCTION

Stereophotogrammetry technology is used by the scientific community to study the soft tissue of the face[1,2] and to evaluate linear, angular, surface and volume measurements. The method is reliable[3,4] and accurate and surpasses two-dimensional (2D) photography.[5] The noncontact 3D surface capture method is a noninvasive technique that offers advantages including direct measurements.[6] Facial proportion measurements are essential for the clinician when the planned treatment involves tooth and facial soft tissue changes, such as with orthodontics,[7] plastic surgery,[8] and complete mouth rehabilitation.[9–11]

Oral rehabilitation with complete dentures has been widely studied and the rate of the edentulous population in developing countries is expected to grow.[12] Edentulism is still considered a public health problem by the World Health Organization.[13,14] The etiology of edentulism involves microbial or genetic diseases and iatrogenic, traumatic, or therapeutic causes.[15,16] Edentulous patients experience difficulties with chewing and speech, and also with poor facial aesthetics.[10,16,17] Edentulism is associated with facial collapse, leading to shortening in the lower third of the face, deep wrinkles, and visible drooping of the related labial commissures become visible .[9,18] Loss of function and aesthetics problems are also associated with a poor quality of life in these patients.[10,17]

Prosthetic treatment with different types of complete denture, a conventional complete denture (CCD) or implant-supported complete denture (ISCD), can restore masticatory function with artificial teeth and help maintain a natural facial appearance. The lower third of the face has a notable impact on the facial appearance. For complete denture wearers to retain a natural appearance,[19,20] adequate lip support and an appropriate occlusal vertical dimension (OVD) must be provided.[21] These are the aims of these two types of prostheses, even though they have different indications and characteristics in terms of mechanical retention, the amount of acrylic resin material and the occlusal scheme.

Lip support with complete dentures has been evaluated[21–24] but CCDs have a labial flange that is absent with ISCDs.[22] The flange is defined as the portion of a complete denture

that occupies the buccal surface[25] but has been reported to provide only minimal and clinically insignificant differences in lip support.[23]

Studies that measured changes in facial proportions after oral rehabilitation with complete dentures are sparse,[18] althoughfacial changes before and after oral rehabilitation with CCDs[9,11] and ISCDs[24] have been measured with stereophotogrammetry. However, the authors are unaware of a study comparing how different prostheses affect facial aesthetics and that quantifies facial collapse based on a control group (CG).

The present research aimed to quantify facial collapse caused by tooth loss compared with a dentate patient (CG) and to quantify whether two different types of complete dentures can restore facial proportions similar those of the CG by stereophotogrammetry. The null hypothesis tested was that those rehabilitated with complete dentures, conventional or implant-supported, would show no differences from dentate individuals.

2 MATERIAL AND METHODS

2.1 Sample selection

This study was conducted after approval by the institutional review board. Written informed consent was obtained from all participants under protocol number CAAE: 99721718.6.0000.5417. The sample was composed of 104 individuals, edentulous patients (mean age 62.23±7.15 years), and dentate patients (mean age 60.06±4.95 years). The edentulous group (n=56/19 male and 37 female) was analyzed under two different clinical conditions and compared with the CG (n=48/26 male and 22 female). The initial clinical situation was before oral rehabilitation, and the final clinical condition was after the delivery of two different types of complete dentures in both arches: a conventional complete denture, the CCD group (n=28) and the implant-supported complete denture, the ISCD group (n=28) (Figure1).

The sample size calculation was based on a pilot study according to the *t* test adopted in the present study. Considering a minimum relevant difference of at least 2.3 mm in the

alteration of the soft tissues (standard deviation, 2.97 mm) as previously evaluated in the studied population, adopting a significance of 0.05 and test power of 0.80, the sample size obtained was at minimum 28 participants.[11] The inclusion criteria for the edentulous group were that they had been edentulous at least five and no more than 15 years; indication of CCD and ISCD in both arches, fabricated between 2019 and 2021, by one prosthodontist, and one dental laboratory technician. The inclusion criteria for the CG group were individuals with an OVD maintained by natural teeth without removable prostheses. The exclusion criteria for both groups were aesthetic procedures on the face and compromised neuromuscular health.

2.2 Image acquisition

The facial analysis was performed through 3D stereophotogrammetry with the VECTRA H1 device (Canfield Scientific Inc, Fairfield, NJ, USA). A sequence of 17 anthropometric landmarks[26] was marked on the face with an eyeliner by two previously calibrated examiners (Table 1). The CCD and ISCD groups underwent 3D facial analysis twice on the same day, the first time with the dentures in place and the second without (Figures 2 and 3). The CG group was examined only once by stereophotogrammetry. The analysis was performed by using the Vectra Analysis Module software (VAM elaboration, Canfield Scientific Inc., Fairfield, NJ, USA) though linear, angular, surface, perimeter and volume measurements (Table 1).

The analysis of the superimposition of 3D images was performed to show the changes in the facial contours of the edentulous group after rehabilitation. The root-main square (RMS) equal to 0.20 was considered accurate,[4] and the matched areas were through the non-changed, as the forehead, surrounded by the points (TR – G – TL - Tr). A chromatogram map was generated, representing unchanged areas (in green) and decreased (in red) and increased (in blue) facial volumes (Figure 4).

The kappa coefficient was applied to check the agreement between the operators who made the anthropometric landmarks on the face (0.81 for the analog landmarks and 0.84 for the digital landmarks). The operators saved the landmarks on the system after calibration. Only

the MGRP operator performed the quantitative analysis based on the anthropometric landmarks defined and previously saved.

2.3 Statical Analysis

The Kolmogorov-Smirnov test was used to test the normality of the data ($p > 0.05$). The independent *t* test was used to compare the initial clinical condition of the edentulous group with the CG group, and the one-way ANOVA to compare the groups after oral rehabilitation. All statistical analyses were performed with open-source software Jamovi v.1.2 (The jamovi project, Sydney, Australia) with a significance level of 0.05 and a test power of 0.80.

TABLE 1 List of abbreviations and definitions of the measurements.

Linear Measures	**Definition**
Tr – G	Upper third of the face;
G – Sn	Middle third of the face;
Sn – Gn	Lower third of the face;
N – Pg	Distance between nasion and pogonion;
Sn - Pg	Lower facial height;
Ls - Li	Height of the upper and lower vermilion;
Sn - Ls	Height of the cutaneous upper lip;
Ex (R) - Ch (R')	Distance between exocanthion and cheilion' (right);
Ex (L) - Ch (L')	Distance between exocanthion and cheilion' (left);
Ac (R) – Ac (L)	The width between the alar curvature;
Al (R) – Al (L)	Nasal width;
ChR- ChL	Labial fissure width;
CphR - CphL	Width of the philtrum;
Angular Measures	**Definition**
Prn-Sn-Ls	Nasolabial angle;
Ls-St-Li	Sealed lips angle;
Sn-St-Pg	Lower facial convexity;
T(R) – Prn – T(L)	Middle facial convexity;
T(R) – Pg – T(L)	Lower facial convexity;
Go(R) – Pg - Go(L)	Mandibular convexity;
N–Sn–Pg	Facial convexity (excluding nose);
T(R)-Go(R)-Pg	Right gonial angle;
T(L)-Go(L)-Pg	Left gonial angle;
3D Measures	
Ac(L)-T(L)-Go(L)-Gn-Go(R)-T(R)-Ac(R)	Surface of the lower third of the face
Ac(L)-T(L)-Go(L)-Gn-Go(R)-T(R)-Ac(R)	Perimeter of the lower third of the face
Ac(L)-T(L)-Go(L)-Gn-Go(R)-T(R)-Ac(R)	Volume of the lower third of the face

3 RESULTS

One hundred and four edentulous (mean age 62.23±7.15 years), and dentate (mean age 60.06±4.95 years) individuals were evaluated with no statistical differences between ages ($p = 0.07$). The edentulous group (n=56/19 male and 37 female) was compared with the CG (n=48/26 male and 22 female) (Table 2) and the rehabilitation with CCD, ISCD, and control group was compared among them (Table 3).

Table 2 quantified the facial collapse in the edentulous participants. The analysis was based on edentulous and dentate participants, and the results showed statistically significant differences in eight linear measurements, five angular measurements and the surface and perimeter.

The comparisons among the prosthesis types (CCD and ISCD) and the CG showed statistically significant differences in six linear and four angular measurements and the surface and perimeter (Table 3).

TABLE 2 Comparison of linear, angular and lower third of the face measurements between the edentulous group (n=56) and the control group (n=48).

Linear measures (13)	**Edentulous Group (n=56) Mean±SD**	**CG (n=48) Mean±SD**	**p ≤ 0.05**
Tr-G	52.9±9.70	55,9±10.57	0.10
G-Sn	62.51±4.73	63.16±5	0.50
Sn-Gn	66.00±5.80	68.75±6.08	**0.02***
N-Pg	103.50±8.22	106.93±7.90	**0.03***
Sn-Pg	52.72±5.39	55.7±6.07	**0.009***
Ls-Li	7.81±2.86	11.3±2.99	**< .001***
Sn-Ls	18.02±3.02	18.5±3.11	0.402
ExR-Ch'R	65.7±4.58	69.2±5.48	**< .001***
ExL-Ch'L	65.6±4.75	69.1±5.3	**< .001***
ChR-ChL	46.3±6.51	51.6±5.07	**< .001***
CphR-CphL	11.34±1.82	12.3±2.11	**0.014***
AcR-AcL	35.46±3.49	35±3.52	0.55
AlR-AlL	35.57±3.79	35.9±3.89	0.70
Angular Measures (9)	**Edentulous Group (n=56) Mean±SD**	**CG (n=48) Mean±SD**	**p ≤ 0.05**
Prn-Sn-Ls	131.66±12.14	121.4±8.84	**< .001***
Ls-St-Li	130.11±17.93	134.2±14.91	0.21
Sn-St-Pg	157.85±13.04	170.4±5.66	**< .001***
TR-Prn-TL	66.13±2.72	64.7±2.53	**0.005***
TR-Pg-TL	63.19±2.32	62.2±2.87	0.06
GoR-Pg-GoL	77.83±4.91	75.4±5.11	**0.017***
N-Sn-Pg	171.21±6.86	167.6±5.71	**0.005***
TR-GoR-Pg	126.78±5.07	125.3±4.97	0.14
TL-GoL-Pg	124.04±6.65	122.2±6.12	0.15
Lower Third of the Face	**Edentulous Group (n=56) Mean±SD**	**CG (n=48) Mean±SD**	**p≤0.05**
Surface	164.4±20.56	178.1±22.33	**0.002***
Perimeter	603.5±34.51	619.2±39.14	**0.032***

SD - standard deviation/ independent *t* test/ * statistically significant difference ($p < 0.05$)

TABLE 3 Comparison of linear, angular and lower third of the face measurements among edentulous group rehabilitated with a conventional complete denture (CCD) (n=28) rehabilitated with complete implant-supported dentures (CDIS) (n=28), and the control group (n=48).

Linear measures (13)	**CCD (n=28) Mean±SD**	**ISCD (n=28) Mean±SD**	**CG (n=48) Mean±SD**	***F***	***P***
Tr-G	53.1±8.4[a]	51.2±10.16[a]	55.9±10.57[a]	1.91	0.15
G-Sn	61.3±5.09[a]	63.4±4.42[a]	63.2±5[a]	1.65	0.2
Sn-Gn	66.2±4.95[a]	71.4±5.37[b]	68.8±6.08[ab]	7.07	**0.002**
N-Pg	102.4±7.44[a]	108.8±5.77[b]	106.9±7.9[b]	6.32	**0.003**
Sn-Pg	53.4±5.48[a]	57.2±4.8[b]	55.7±6.07[ab]	3.81	**0.02**
Ls-Li	10.8±2.51[a]	12.7±2.86[b]	11.3±2.99[ab]	3.70	**0.03**
Sn-Ls	16.8±3.3[a]	18.3±2.39[a]	18.5±3.11[a]	2.50	0.09
ExR-Ch'R	65.4±5.06[a]	67.6±3.77[ab]	69.2±5.48[b]	4.73	**0.01**
ExL-Ch'L	65.4±5.62[a]	67.8±3.97[ab]	69.1±5.3[b]	4.14	**0.02**
ChR-ChL	50.8±4.62[a]	53.4±5.91[a]	51.6±5.07[a]	1.65	0.2
CphR-CphL	11.8±1.74[a]	12.9±1.81[a]	12.3±2.11[a]	2.80	0.06
AcR-AcL	36.7±3.44[a]	35±3.47[a]	35±3.52[a]	2.36	0.10
AlR-AlL	34.9±3.42[a]	36.7±4.29[a]	35.9±3.89[a]	1.58	0.21
Angular Measures (9)	**CCCD (n=28) Mean±SD**	**ISCD (n=28) Mean±SD**	**CG (n=48) Mean±SD**	***F***	**Significant**
Prn-Sn-Ls	124.2±11.56[a]	120.4±10.8[a]	121.4±8.84[a]	0.88	0.42
Ls-St-Li	124.4±16.91[a]	130.9±11.51[ab]	134.2±14.91[b]	3.23	**0.04**
Sn-St-Pg	168.7±7.65[a]	166.8±6.48[a]	170.4±5.66[a]	2.99	0.05
TR-Prn-TL	66.3±3.78[a]	65.97±1.96[ab]	64.7±2.53[b]	4	**0.02**
TR-Pg-TL	63.3±2.06[a]	62.8±2.29[a]	62.2±2.87[a]	1.69	0.19
GoR-Pg-GoL	76.8±4.77[a]	79.5±4.75[ab]	75.4±5.11[b]	5.92	**0.004**
N-Sn-Pg	168±8.15[a]	169.4±5.61[a]	167.6±5.71[a]	0.82	0.44
TR-GoR-Pg	127.1±5.32[ab]	128.4±5.1[a]	125.3±4.97[b]	3.34	**0.04**
TL-GoL-Pg	125.6±5.92[a]	126±23.03[a]	122.2±6.12[a]	3.38	0.07
Lower Third of the Face	**CCD (n=28) Mean±SD**	**ISCD (n=28) Mean±SD**	**CG (n=48) Mean±SD**	***F***	**Significant**
Surface	162.1±16.01[a]	171.1±23.03[ab]	178.1±22.33[b]	6.538	**0.003**
Perimeter	593.7±26.79[a]	614±37.51[ab]	619.2±39.14[b]	6.205	**0.004**

SD - standard deviation/ One-way ANOVA/ * statistically significant difference ($p < 0.05$). Means followed by different letters in line differ statistically by Tukey test (5%).

4 DISCUSSION

Changes in the face are notable after oral rehabilitation with complete dentures that can be quantified precisely with stereophotogrammetry technology.[9,11,21,24,27] Facial proportions are evaluated before and after the treatment to understand how the prostheses impacted facial aesthetics.[9,11] Clinicians should model rehabilitation on a dentate patient to achieve similar measures.

One hundred and four individuals were compared to verify facial measurements between the CG and edentulous group and among CCD and ISCD rehabilitation and the CG. The present study is novel in that it compared these two kinds of rehabilitation with a CG. The null hypothesis was partially rejected. The comparison between the edentulous group and the CG presented differences in linear, angular, surface and perimeter measures. Comparing patients rehabilitated with CCD and ISCD and the CG, the differences were observed mainly between the CCD group and control group, while between the ISCD group and control group, only the Tr-GoR-Pg measure showed a statistically significant difference.

4.1 Facial collapse and OVD

Previous studies have quantified facial collapse by analyzing edentulous facial proportions,[9,11,21] and a shortening in the lower third of the face has been observed[18] in edentulous patients. The linear measures assessed in the present study documented how the collapse was represented in the total face evaluation, as the present study compared edentulous patients and the CG of dentate people matched by age.

The edentulous patients presented diminished OVD (Sn-Gn, p=0.02) compared with the CG. Consistent with previous studies,[9,11,24] the change in OVD can significantly affect the lower third of the face (N-Pg, p=0.03; Sn-Pg, p=0.009). Oral rehabilitation with CCD and ISCD restored the facial proportions, increasing these measurements similar to CG, with no statistical differences between prostheses and the CG (Sn-Gn/Sn-Pg: CCD/control group;

N=Pg: ISCD/control group), and, as observed in the Tartaglia et al.[24] study, an increase in the Sn-Pg measure.

4.2 Oral rehabilitation to restore facial proportions

Before oral rehabilitation, the edentulous group differed by eight linear measurements from the CG (Sn-Gn, N-Pg, Sn-Pg, Ls-Li, ExR-Ch'R, ExL-Ch'L, ChR-ChL, CphR-CphL) (Table 2), these differences were reduced to three after delivery of the complete dentures. The measurement differences were mainly between the CCD group and the CG: N- Pg, Ex-Ch' both on the right and left sides (Table 3). The CCD group still presented the lowest values. These results suggest that oral rehabilitation with CCD or ISCD can improve the facial profile as reported in previous studies.[21,22,24] However, treatment with ISCDs provided similar facial metrics to dentate individuals, as no statistical differences with the CG were found in linear, surface and perimeter measurements. Only in one angular measurement (TR-GoR-Pg), was a statistically significant difference observed between ISCD and CG.

The ISCD group mean values were higher than those of the CG in the linear measures, with statistically significant differences except in ExR-Ch'R and ExL-Ch'L. The higher measurements may be explained by the framework in the implant-supported complete denture, and this influence requires further research.

The nasolabial angle and the labial protrusion are influenced by the position of the anterior dentition.[20,21,28] The present investigation corroborated Bidra et al.[23] study that flanged (CCD) and flangeless (ISCD) prostheses were equally viable as they did not differ statistically from each other nor from the CG in terms of the nasolabial angle (Prn-Sn-Ls). This result suggests that clinicians could provide either type of prostheses (CCD and ISCD) in the maxillary arch based on the evaluation of labial support.

The surface and perimeter presented differences in dentate and edentulous patients, with higher values in dentate patients. When evaluating the types of rehabilitation (CCD and ISCD), the ISCD presented results similar to dentate patients.

Limitations of the present investigation included the cross-sectional study design, and those measurements made for only one ethnic group, Caucasian individuals, and the small sample size.

5 CONCLUSION

Facial collapse occurs in the lower third of the face in edentulous patients compared with dentate patients. Rehabilitating patients with implant-supported complete dentures can restore facial proportions similar to those of dentate patients.

FIGURE CAPTIONS

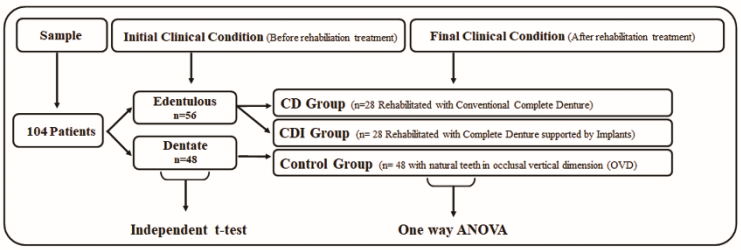

FIGURE 1 Flow chart of the sample and statistical analysis

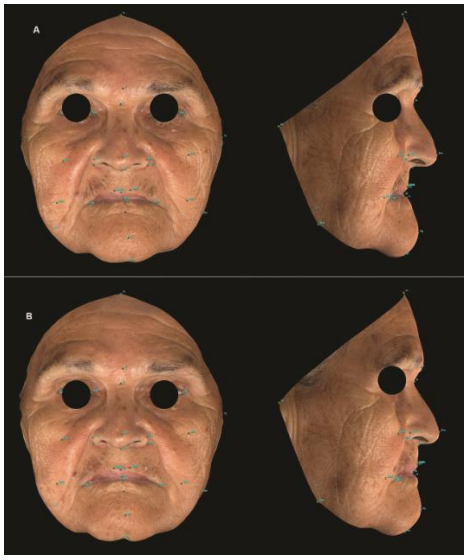

FIGURE 2 A- Edentulous face in frontal and lateral view/ B- Facial changes after oral rehabilitation with conventional removable complete denture

FIGURE 3 A- Edentulous face in frontal and lateral view/ B- Facial changes after oral rehabilitation with complete denture supported by implants

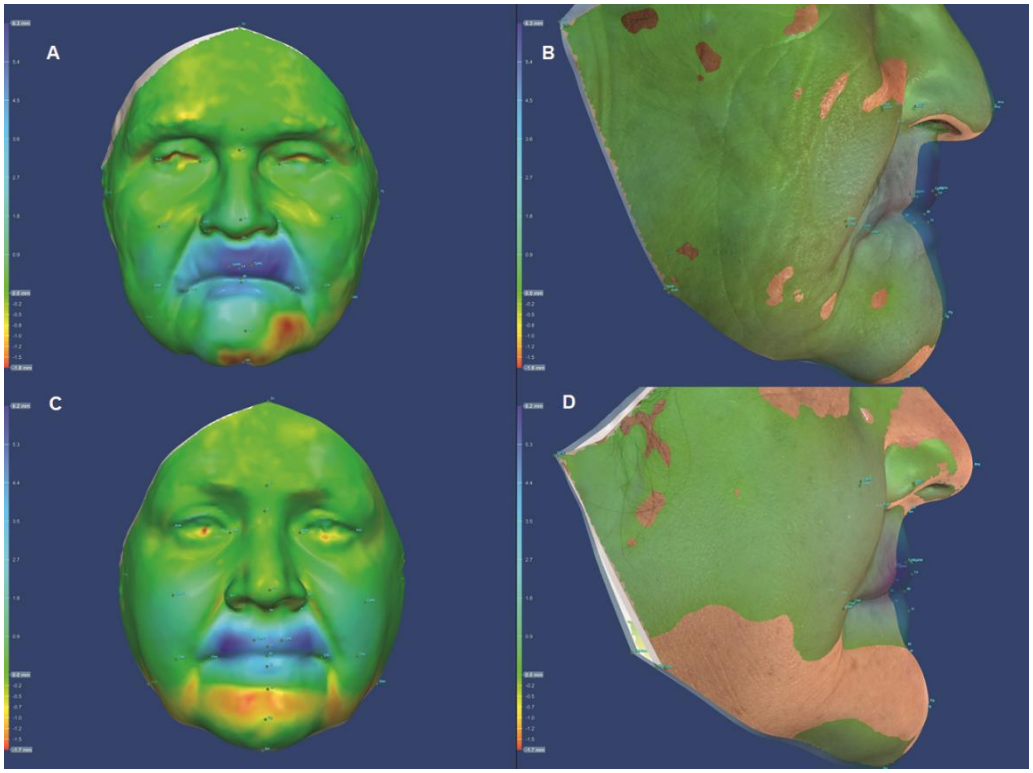

FIGURE 4 A- Facial analysis with different colors of the superimposition with and without complete denture (CD) in frontal view (green, superimposed areas; red and blue, discordant areas between the 2 scans). B- Superimposition of the changes in the lower third of the face with and without complete denture (green, superimposed areas; red and blue, discordant areas between the 2 scans) C-. Facial analysis with different colors of the superimposition with and without complete denture supported by implants (CDI) in frontal view (green, superimposed areas; red and blue, discordant areas between the 2 scans) D- Superimposition of the changes in the lower third of the face with and without complete denture supported by implants (green, superimposed areas; red and blue, discordant areas between the 2 scans)

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3 DISCUSSION

The present study evaluated the facial changes in edentulous patients after rehabilitation. This research involves a representative sample with a minimum of 28 patients in each group, edentulous and dentate people, matched by age in different moments and comparisons.

As expected, significant differences were found in the third lower of the face. The rehabilitation increased the occlusal vertical dimension (OVD) as reported in other studies. [13,22-23] The lower face height in patients without complete dentures compared with dentate patients presented statistically significant results, an expected finding since a stable occlusal relationship was an inclusion criterion in the control group. The soft tissues are supported by teeth as stated by Tang et al.[15], Sterenborg et al. [23] evaluated the effect of complete rehabilitation,[15,23] including an increase of OVD, in patients without tooth wear to detect differences in facial appearance, reporting statistically significant changes in facial appearance of the lower facial height.

However, how complete dentures restore facial proportions is of considerable interest. The esthetics of the soft tissue support assumes the primary importance of facial contours,[12] and the complete dentures provide support for the lips[21] and cheeks.[9,12] Quantifying these changes through stereophotogrammetry helps give the natural appearance of dentate patients to edentulous patients. The discussion of the facial aesthetics involves the lip proportions and the facial angles.

The nasolabial angles (Prn-Sn-Ls) were reduced from without to with complete dentures, and without dentures compared with the control group. The angle reduction was because, as labial support increases, the nasolabial angle reduces.[15,19,24] This angle observed in Brazilian, Chinese, and European individuals, declined by

approximately 7 degrees from before and after delivery of the complete denture.[15,25] However, the Tartaglia et al.[25] study involved implant-supported prostheses. Independent of the different facial proportions among ethnicities, the nasolabial angle, and the labial protrusion are influenced by the position of the anterior dentition.[12,19,26] The present investigation corroborated Bidra et al[21] study that flanged (CCD) and flangeless (ISCD) prostheses were equally viable as they did not differ statistically from each other nor the CG in terms of the nasolabial angle (Prn-Sn-Ls). This result suggests that clinicians could provide either type of prostheses (CCD and ISCD) in the maxillary arch based on the evaluation of labial support.

Labial augmentation is an objective to be achieved in all procedures involving facial aesthetic treatment. Studies that analyzed the three-dimensional structure of the lip are lacking. The present study determined that complete denture treatment increased the labial height, labial surface, and perimeter, providing labial augmentation. The mouth width (ChR-ChL) also increased, mainly because tooth loss contributed to the aged facial aspect induced by reduced fibrous connective tissue and decreased musculature activity.[15,27] The lip dimensions were increased in the vertical and horizontal dimensions, contrary to Tartaglia et al,[25] who reported an increase in vertical and anteroposterior labial dimensions without a change to the mouth width.[25]

The use of stereophotogrammetry facilitates these analyses as it is capable of assessing linear measures and quantifying surface with precision.[22-23,28-30]

The surface and perimeter increase in the lower third of the face when comparing the group without dentures and the control group and the group with dentures and the control group, indicating that the surface and perimeter cannot be restored to the values of the control group after complete denture delivery. However, the surface and perimeter presented differences in dentate and edentulous patients,

with higher values in dentate patients. When evaluating the types of rehabilitation (CCD and ISCD), the ISCD presented results similar to dentate patients.

The limitations of this study included the sample with the differences in sex distribution and the cross-sectional study design. In addition, bone resorption was not quantified, and also only Caucasian individuals were evaluated.

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ANNEX A - APROVAÇÃO COMITÊ DE ÉTICA

USP - FACULDADE DE ODONTOLOGIA DE BAURU DA USP

Plataforma Brasil

PARECER CONSUBSTANCIADO DO CEP

DADOS DA EMENDA

Título da Pesquisa: Avaliação do perfil facial após reabilitação oral com próteses totais utilizando Estereofotogrametria

Pesquisador: Maria Giulia Rezende Pucciarelli

Área Temática:

Versão: 4

CAAE: 99721718.6.0000.5417

Instituição Proponente: Universidade de Sao Paulo

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 4.791.223

Apresentação do Projeto:

Trata-se de uma emenda ao projeto de doutorado intitulado "Avaliação do perfil facial após reabilitação oral com próteses totais utilizando Estereofotogrametria", tendo como pesquisadora principal Maria Giulia Rezende Pucciarelli e equipe de pesquisa composta pela Profa. Dra. Simone Soares (orientadora), Jorge Tomasio Caballero, Guilherme Hideki de Lima Toyoshima, Jefferson Freire Cardoso, Laura Vidoto Paludetto, Guilherme Yukio Arakaki Murayama e Maria Gabriela Robles Mengoa. O presente trabalho pretende utilizar a tecnologia 3D de aquisição de imagens por estereofotogrametria para avaliar a face de pacientes que utilizam próteses totais e comparar com indivíduos com dentição completa e idade entre 50 a 75 anos. A análise será realizada em 90 pacientes que serão recrutados na clínica de pós-graduação, atendidos no curso de Reabilitação Oral, da Faculdade de Odontologia de Bauru da Universidade de São Paulo (FOB/USP), todos regularmente matriculados na instituição de ensino e em rotina de atendimento. Os participantes selecionados serão divididos em 3 grupos contendo 30 participantes em cada grupo: G1- 30 pacientes com dentição completa; G2- 30 pacientes que possuem prótese total dupla; G3- 30 pacientes que possuem prótese total dupla implantussuportada.

Objetivo da Pesquisa:

Hipótese:

Hipótese Nula: Não há diferença entre o perfil facial de pacientes desdentados que utilizam

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continua

continuação

próteses totais e pacientes com a dentição completa.

Objetivo Primário:

O objetivo geral do presente trabalho será realizar uma análise do perfil facial de pacientes reabilitados com próteses totais implantossuportadas, tipo Protocolo e de pacientes reabilitados com próteses totais convencionais duplas, comparando com o perfil facial de pacientes não portadores de próteses, tais avaliações tem o objetivo de comparar os parâmetros faciais estabelecidos e verificar a real influência da reabilitação no reestabelecimento do perfil facial.

Objetivo Secundário:

2.1 – Comparar os perfis faciais de pacientes reabilitados com próteses totais sobre implantes com os indivíduos que receberam próteses totais convencional, verificando o quanto cada tipo de prótese estudada interfere no padrão facial.

2.2 – Comparar os perfis faciais de pacientes reabilitados com próteses totais implantossuportadas e convencional com pacientes que não utilizam próteses, com o intuito de avaliar se o tratamento com próteses se aproxima do perfil facial adequado, se comparado com pacientes com a dentição completa.

Avaliação dos Riscos e Benefícios:

Riscos:

Os riscos que a pesquisa apresenta são mínimos: tal como o paciente sentir-se cansado durante a realização da avaliação bucal e as fotografias, em vista disso, haverá uma cadeira no local para descanso.

Benefícios:

Os benefícios serão inúmeros, visto que com a avaliação facial dos pacientes que utilizam próteses totais deve-se aproximar do perfil facial de uma pessoa com a dentição completa, será possível avaliar o sucesso da prótese ou onde deve-se melhorar para atingir o padrão facial estético e funcional para o paciente, porque através dessa analise é possível saber se a dimensão vertical de oclusão está correta, se as próteses totais devolveram corretamente a distância do terço inferior da face, o qual é perdido com a perda dentária completa, se a função das próteses estão adequadas e se aproxima de uma paciente que não perdeu os elementos dentários ao longo dos anos.. Além de todos os participantes passarem por uma avaliação bucal, juntamente com orientações de higiene, caracterizando benefícios diretos para os pacientes, se durante a avaliação odontológica for detectado alguma alteração bucal o mesmo será encaminhado para o setor de Triagem.

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USP - FACULDADE DE ODONTOLOGIA DE BAURU DA USP

Continuação do Parecer: 4.791.223

Comentários e Considerações sobre a Pesquisa:

Trata-se de uma emenda com o objetivo de acrescentar os nomes de Jefferson Freire Cardoso, Laura Vidoto Paludetto, Guilherme Yukio Arakaki Murayama e Maria Gabriela Robles Mengoa como parte integrante da equipe de pesquisa.

Considerações sobre os Termos de apresentação obrigatória:

Foram anexados todos os currículos dos novos integrantes da equipe de pesquisa na PB.

Recomendações:

Não se aplica.

Conclusões ou Pendências e Lista de Inadequações:

Trata-se de uma emenda com o objetivo de acrescentar os nomes de Jefferson Freire Cardoso, Laura Vidoto Paludetto, Guilherme Yukio Arakaki Murayama e Maria Gabriela Robles Mengoa como parte integrante da equipe de pesquisa. A pesquisadora nos apresentou um ofício fazendo a solicitação e anexou todos os currículos dos novos envolvidos na pesquisa na PB, razão pela qual podemos aprovar a solicitação apresentada a este CEP. Apenas observamos que o nome da nova pesquisa Maria Gabriela Robles Mengoa está incompleto na PB. Lá seu nome foi lançado apenas como Gabriela Robles Mengoa (faltou Maria).

Considerações Finais a critério do CEP:

Esse projeto foi considerado APROVADO na reunião ordinária do CEP de 02/06/2021, via Google Meet, devido à pandemia da COVID-19 e por orientações da CONEP, com base nas normas éticas da Resolução CNS 466/12. Ao término da pesquisa o CEP-FOB/USP exige a apresentação de relatório final. Os relatórios parciais deverão estar de acordo com o cronograma e/ou parecer emitido pelo CEP. Alterações na metodologia, título, inclusão ou exclusão de autores, cronograma e quaisquer outras mudanças que sejam significativas deverão ser previamente comunicadas a este CEP sob risco de não aprovação do relatório final. Quando da apresentação deste, deverão ser incluídos todos os TCLEs e/ou termos de doação assinados e rubricados, se pertinentes.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_1754355_E1.pdf	17/05/2021 15:10:10		Aceito

Endereço: DOUTOR OCTAVIO PINHEIRO BRISOLLA 75 QUADRA 9
Bairro: VILA NOVA CIDADE UNIVERSITARIA **CEP:** 17.012-901
UF: SP **Município:** BAURU
Telefone: (14)3235-8356 **Fax:** (14)3235-8356 **E-mail:** cep@fob.usp.br

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USP - FACULDADE DE ODONTOLOGIA DE BAURU DA USP

Continuação do Parecer: 4.791.223

Outros	Oficioemendacep.pdf	17/05/2021 15:06:20	Maria Giulia Rezende Pucciarelli	Aceito
Outros	OFICIODERESPOSTAScorrigidoeassinado.docx	18/12/2018 17:25:53	Maria Giulia Rezende Pucciarelli	Aceito
Outros	OFICIODERESPOSTASsegundoparecerassinado.jpg	18/12/2018 16:43:22	Maria Giulia Rezende Pucciarelli	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLEcorrigido.docx	18/12/2018 16:41:40	Maria Giulia Rezende Pucciarelli	Aceito
Cronograma	CRONOGRAMADEEXECUCAOCEP.docx	18/12/2018 16:40:53	Maria Giulia Rezende Pucciarelli	Aceito
Orçamento	ORCAMENTODETALHADO.docx	08/11/2018 15:42:35	Maria Giulia Rezende Pucciarelli	Aceito
Projeto Detalhado / Brochura Investigador	PROJETOESTEROFOTOGRAMETRIAcorrigido.docx	08/11/2018 15:26:09	Maria Giulia Rezende Pucciarelli	Aceito
Outros	aquiescenciapendencia.jpg	08/11/2018 15:11:43	Maria Giulia Rezende Pucciarelli	Aceito
Declaração de Pesquisadores	declaracaopesquisadores.jpg	08/11/2018 14:50:46	Maria Giulia Rezende Pucciarelli	Aceito
Folha de Rosto	rosto.pdf	24/09/2018 17:15:33	Maria Giulia Rezende Pucciarelli	Aceito
Declaração de Instituição e Infraestrutura	CartadeEncaminhamentoDepartamento.jpg	06/09/2018 15:02:03	Maria Giulia Rezende Pucciarelli	Aceito
Outros	QuestionarioTecnicoPesquisador.doc	04/09/2018 19:43:57	Maria Giulia Rezende Pucciarelli	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

BAURU, 18 de Junho de 2021

Assinado por:
Juliana Fraga Soares Bombonatti
(Coordenador(a))

Endereço: DOUTOR OCTAVIO PINHEIRO BRISOLLA 75 QUADRA 9
Bairro: VILA NOVA CIDADE UNIVERSITARIA **CEP:** 17.012-901
UF: SP **Município:** BAURU
Telefone: (14)3235-8356 **Fax:** (14)3235-8356 **E-mail:** cep@fob.usp.br

ANNEX B - TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Universidade de São Paulo
Faculdade de Odontologia de Bauru

Departamento de Prótese e Periodontia

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Convidamos o (a) Senhor (a)_____para participar da pesquisa **"Avaliação do perfil facial após reabilitação oral com próteses totais utilizando Estereofotogrametria"**

O perfil facial influencia na estética, fonética e função, e a perda dos dentes causa no perfil facial uma influência negativa, a qual as próteses totais de diversos tipos, tem o objetivo de devolver a proporção facial adequada.

Sua participação consistirá em autorizar, uma avaliação bucal e três tomadas fotográficas utilizando uma câmera adequada 3D, em sessão única de 40 minutos em média, para a realização das medidas faciais.

Os participantes serão recrutados na Clínica I da Faculdade de Odontologia de Bauru da Universidade de São Paulo (FOB/USP), nas disciplinas de Prótese I e II, e após o atendimento serão então convidados a participar da pesquisa.

As fotografias e a avaliação serão realizadas no departamento de Prótese e Periodontia, as imagens serão imediatamente passadas para o computador próprio da pesquisa a qual apenas os envolvidos na equipe de pesquisa terão acesso, as imagens serão analisadas pelo software adequado e serão levadas em consideração apenas as medidas analisadas, sendo assim, as tomadas fotográficas não serão divulgadas e as mesmas serão descartadas.

Os pesquisadores envolvidos tentarão minimizar ao máximo qualquer tipo de risco, por exemplo o cansaço do paciente. Uma vez que os participantes autorizarem as tomadas fotográficas, todos os participantes passarão por uma avaliação bucal, juntamente com orientações de higiene, caracterizando benefícios diretos para os participantes, se durante a avaliação odontológica for detectado alguma alteração bucal o mesmo será encaminhado para o setor de Triagem. Se tratando de participantes idosos, essa avalição é de extrema importância.

Apenas a equipe de pesquisa estará no local reservado: "laboratório de prótese", não podendo ter mais pessoas no local próprio para coletas as imagens. Se o participante se queixar de cansaço, em vista de minimizar esse risco, haverá uma cadeira no local para descanso, visando o conforto dos participantes e para que os mesmos fiquem a vontade de desistir de participar, porém fica assegurado aos indivíduos participantes o direito a indenização caso algum dano dela decorra. Os gastos que forem gerados por este trabalho ficarão a cargo do responsável pelo projeto.

O benefício indireto resultante desse trabalho será a possibilidade de avaliar o perfil facial dos usuários de prótese totais, observando se a mesma está sendo satisfatória e se aproxima ao perfil facial de indivíduos que possuem toda a dentição, visto que devolver proporção facial está diretamente ligada a estética, fonética e função.

O participante da pesquisa receberá uma via deste documento, assinado e rubricado por ele próprio e pelo pesquisador responsável. Para o desenvolvimento dessa pesquisa, sua participação é fundamental, mas não obrigatória. e todas as informações serão **CONFIDENCIAIS**, podendo ser publicadas apenas para fins científicos, portanto sem a identificação dos participantes. A qualquer momento poderá ser pedido mais informações ou até mesmo negar-se a continuar participando da pesquisa sem qualquer penalidade.

Rubrica do Pesquisador Responsável:

Rubrica do Participante da Pesquisa:

Al. Dr. Octávio Pinheiro Brisolla, 9-75 – Bauru-SP – CEP 17012-901 – C.P. 73
e-mail: dep-prot@fob.usp.br– Fone/FAX (0xx14) 3235-8277
http://www.fob.usp.br

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Departamento de Prótese e Periodontia

Desde já agradecemos a colaboração e nos colocamos à disposição para mais esclarecimentos que se fizerem necessários. Se restarem dúvidas, o participante poderá entrar em contato com o responsável pelo estudo (Maria Giulia Rezende Pucciarelli), pelo telefone (14) 3235-8277, pelo e-mail mgpucciarelli@usp.br ou pelo endereço: Departamento de Prótese, da Faculdade de Odontologia de Bauru/USP, Alameda Dr. Octávio Pinheiro Brisolla, 9-75.

Para denúncias e/ou reclamações, entrar em contato com Comitê de Ética em Pesquisa-FOB/USP, à Alameda Dr. Octávio Pinheiro Brisolla, 9-75, Vila Universitária, ou pelo telefone (14)3235-8356, e-mail: cep@fob.usp.br.

Pelo presente instrumento que atende às exigências legais, o Sr. (a) _____ _____, portador da cédula de identidade _____, após leitura minuciosa das informações constantes neste TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO, devidamente explicada pelos profissionais em seus mínimos detalhes, ciente dos serviços e procedimentos aos quais será submetido, tais como a avaliação bucal e as fotografias, não restando quaisquer dúvidas a respeito do lido e explicado, DECLARA E FIRMA seu CONSENTIMENTO LIVRE E ESCLARECIDO concordando em participar da pesquisa proposta. Fica claro que o participante da pesquisa ou seu representante legal, pode a qualquer momento retirar seu CONSENTIMENTO LIVRE E ESCLARECIDO e deixar de participar desta pesquisa e ciente de que todas as informações prestadas tornar-se-ão confidenciais e guardadas por força de sigilo profissional (Art. 9º do Código de Ética Odontológica (Res. CFO-118/2012)).

Por fim, como pesquisador(a) responsável pela pesquisa, DECLARO o cumprimento do disposto na Resolução CNS nº 466 de 2012, contidos nos itens IV.3 e IV.4, este último se pertinente, item IV.5.a e na íntegra com a resolução CNS nº 466 de dezembro de 2012.

Por estarmos de acordo com o presente termo o firmamos em **DUAS VIAS** igualmente válidas (uma via para o participante da pesquisa e outra para o pesquisador) que serão **rubricadas em todas as suas páginas** e assinadas ao seu término, conforme o disposto pela Resolução CNS nº 466 de 2012, itens IV.3.f e IV.5.d.

Bauru, SP, _____ de _____ de _____.

_____	_____
Assinatura do Participante da pesquisa	Maria Giulia Rezende Pucciarelli (Pesquisador responsável)

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Universidade de São Paulo
Faculdade de Odontologia de Bauru
Departamento de Prótese e Periodontia

O **Comitê de Ética em Pesquisa – CEP**, organizado e criado pela **FOB-USP**, em 29/06/98 **(Portaria GD/0698/FOB)**, previsto no item VII da Resolução nº 466/12 do Conselho Nacional de Saúde do Ministério da Saúde (publicada no DOU de 13/06/2013), é um Colegiado interdisciplinar e independente, de relevância pública, de caráter consultivo, deliberativo e educativo, criado para defender os interesses dos participantes da pesquisa em sua integridade e dignidade e para contribuir no desenvolvimento da pesquisa dentro de padrões éticos.
Qualquer denúncia e/ou reclamação sobre sua participação na pesquisa poderá ser reportada a este CEP:

Horário e local de funcionamento:
Comitê de Ética em Pesquisa
Faculdade de Odontologia de Bauru-USP - Prédio da Pós-Graduação (bloco E - pavimento superior), de segunda à sexta-feira, no horário das 13h30 às 17 horas, em dias úteis.
Alameda Dr. Octávio Pinheiro Brisolla, 9-75
Vila Universitária – Bauru – SP – CEP 17012-901
Telefone/FAX(14)3235-8356
e-mail: cep@fob.usp.br

Rubrica do Pesquisador Responsável:

Rubrica do Participante da Pesquisa: