

Divine Proportion in edentulous subjects: Assessment before and after complete dentures

Proporção Divina em pacientes edêntulos: Avaliação pré e pós-reabilitação com prótese total

Abstract

Purpose: The aim of this study was to evaluate ratios between bone structures of the skull and the face of edentulous subjects, before and after prosthodontic treatment with complete dentures.

Methods: New complete dentures were fabricated by conventional methods, and subjects ($n=30$) were evaluated cephalometrically before and after the new prosthesis. Using the same cephalometric unit, standardized lateral cephalometric headfilms were made on each subject in two times: the first without the complete dentures, in the rest position of the mandible, and the second with the new one in place, in maximal intercuspation. The lateral cephalometric x-rays were digitized and analyzed using computer software Radiocef Studio 2 – Radiomemory (Belo Horizonte, Minas Gerais, Brazil). The means of 7 different ratios were statistically analysed by paired t-test and Student's t-test, and compared with the golden number 1,618.

Results: There were no statistically significant results in ratios orbitale-menton/condilion-gonion, pogonion-opisthion/orbitale-menton and pogonion-opisthion/posterior nasal spine-opisthion, before and after prosthodontic treatment. The ratios orbitale-menton/anterior nasal spine-posterior nasal spine, orbitale-menton/nasion-anterior nasal spine, orbitale-menton/opisthion-nasion and nasion-menton/anterior nasal spine-menton were different statistically.

Conclusion: The ratio nasion-menton/anterior nasal spine-menton wich relates two important segments, the total anterior facial height and the lower anterior facial height, was closer to the golden number after news complete dentures.

Key words: Complete denture; x-rays; cephalometry

Resumo

Objetivo: Avaliar as razões entre estruturas ósseas cranianas e da face de pacientes edêntulos, antes e após tratamentos com próteses totais.

Metodologia: Próteses totais foram fabricadas por métodos convencionais, e pacientes ($n=30$) foram avaliados cefalometricamente antes e após as novas próteses. Utilizando os mesmos equipamentos cefalométricos, radiografias cefalométricas foram feitas em cada paciente em dois momentos: sem as próteses totais, com posição de repouso mandibular, e com as novas próteses ajustadas, em posição de máxima intercuspidação. Os exames radiográficos cefalométricos foram digitalizados e analisados por meio do programa Radiocef Studio 2 – Radiomemory. As 7 diferentes razões foram analisadas estatisticamente pelo teste t pareado e teste t de student, e comparado com o número áureo 1,618.

Resultados: Não houve resultados estatisticamente significantes nas razões orbital-mento/condílio-gônio, pogônio-opístio/orbital-mento e pogônio-opístio/espinha nasal posterior-opístio, antes e após o tratamento protético. As razões orbital-mento/espinha nasal anterior-espinha nasal posterior, orbital-mento/násio-espinha nasal anterior, orbital-mento/opístio-násio e násio-mento/espinha nasal anterior-mento foram estatisticamente diferentes.

Conclusão: A razão násio-mento/espinha nasal anterior-mento que relaciona dois importantes seguimentos, a altura facial anterior *total* e a altura facial anterior *inferior*, estava mais próxima do número ouro após as novas próteses totais.

Palavras-chave: Prótese total; raios-x; cefalometria

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Introduction

Despite the priority given to current preventive dental care and reduction of edentulous subjects over the last decades, there is still, in developing countries, an effective demand of patients who need prosthodontic treatment using complete dentures.

The Divine Proportion has been studied at least since the Renaissance. According to researchers, it represents the most pleasant proportion between two segments or two measures. It was identified as being equivalent to 1.618:1, and conventionalized to identify it by Phi (ϕ), in honor to the sculptor and architect Phidias, who used the divine proportion in many of his researches (1,2).

In relation to the prosthodontic treatment, there are still few studies related to cephalometric measures and the divine proportion as a tool in the final results evaluation (3-6). Among other concerns to achieve the objectives of the treatment, there is a need to highlight a proper position of the mandible in relation to the maxilla, both in the horizontal plane as in vertical (4,7-9).

In this way, the objective of this radiographic study was to evaluate the divine proportion in some skulls bone structures measurements of edentulous patients, before and after treatment with complete dentures, using lateral cephalometric radiographs. The tested hypothesis is that the ratio of this cephalometric measurements is closely related to the Divine Proportion after prosthodontic treatment.

Methodology

Ethical approval was obtained from the local committee on research ethics (protocol n° 090/2007). Thirty edentulous subjects wearing maxillary and mandibular complete denture were selected for this study.

New complete dentures were fabricated, by conventional methods, for all the patients at the Department of Dental Materials and Prosthodontics, School of Dentistry, São Paulo State University. The radiographies were performed at the Clinic of Radiology, Department of Diagnosis and Surgery, in the same University.

Using the same cephalometric unit, standardized lateral cephalometric headfilms were made on each subject in two times: the first without the complete dentures, in the rest position of the mandible, and the second with the new one in place, in maximal intercuspation. The lateral cephalometric x-rays were digitized and analyzed using computer software Radiocef Studio 2 – Radiomemory (Belo Horizonte, Minas Gerais, Brazil).

According to Gil and Medici-Filho (10), to verify the divine proportion of skull and facial bone structures, it is necessary to obtain ratios for these structures, that is the quotient between two factors, which are obtained by the distance between two points.

Thus, the following points of references were considered: Orbitale (Or)- the lowest point on the margin of the orbit; Menton (Me)- the lowest point of the contour

of the mandibular symphysis; Anterior nasal spine (Ena)- the anterior point of the nasal floor; Posterior nasal spine (Enp)- the posterior point of the nasal floor; Gonion (Go)- most inferior, posterior, and lateral point on the external angle of the mandible; Condillion (Co)- most superior posterior point on condyle; Nasion (N)- most anterior point of nasofrontal suture in the midsagittal plane; Pogonion (Pog)- most anterior point in the contour of the chin in the sagittal plane; Opisthion (Op)- the midpoint on the posterior margin of the foramen magnum.

Searching for the divine proportion of skull and facial bone structures, the ratios R1 Or-Me/Co-Go, R2 Or-Me/Ena-Enp, R3 Or-Me/N-Ena, R4 Op-N/Or-Me, R5 N-Me/Ena-Me, R6 Pog-Op/Or-Me e R7 Pog-Op/Enp-Op were selected consonant to Gil and Medici-Filho (10), and separated in two groups, before denture (BD) and after denture (AD) (Figure 1).

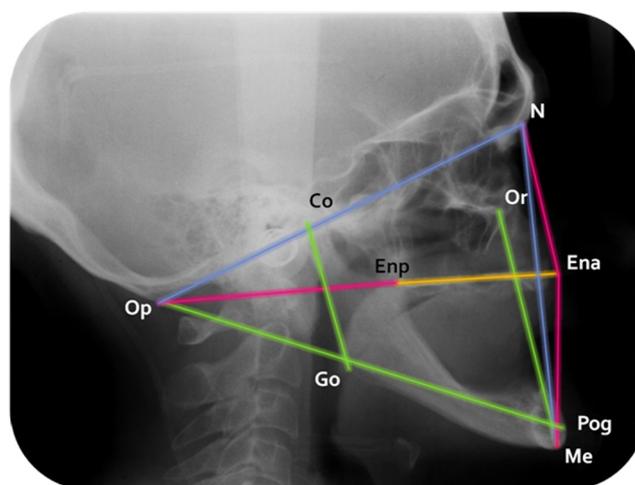


Fig. 1. Points, factors and ratios, in lateral cephalometric x-rays.

The means of each ratio, in both different situations, were statistically analysed by paired t-test and Student's t-test, and compared with the golden number 1,618.

In order to evaluate the error intra-examiner the landmarks in each cephalometric x-rays were performed by one operator, previously trained, in two distinctive times, within a 30 days interval, between the first and second evaluation.

Results

The values were submitted to paired *t* test, which tested the hypothesis that there are differences between the means of the ratios between the groups, BD and AD, and Student's *t* test, to verify that each ratio evaluated may be considered as a Divine Proportion, which then tested the hypothesis that the mean of each group is 1.618, adopting the significance level of 5%.

The intra-examiner error evaluation showed no differences, statistically significant, between the first and second evaluation of all measures which composed the ratio studied. Therefore, there was no significant method error and the average values between the two evaluations were used in the statistical analysis of the ratio.

The difference of the ratio averages between the groups BD and AD, that is, before and after of the complete denture treatment, was verified by the paired *t* test. The ratios for R2, R3, R4 and R5 wer statistically significantly ($P<0.05$).

In order to verify the presence of golden ratios among groups, the groups BD and AD, were compared to the golden number by Student's *t* test. The ratios Op-N/Or-Me (R4) and Pog- Op/Or-Me (R6), of the group BD, Or-Me/Co-Go (R1), of the group AD, did not present differences statistically significant to 5%, which means, do not differ from 1.618. (Table 1; Figure 2).

Discussion

The divine proportion represents the most enjoyable proportion between two segments or two measures. Stable and aesthetically pleasant structures, balanced and functionally efficient, are related to this proportion (2-6).

Esthetics is a primary consideration for patients seeking prosthodontic treatment. The change of the facial vertical dimension can deteriorate the facial harmony (8,9-12). Since the introduction of a standardized method for obtaining skull radiographs, cephalometrics has become one of the possible diagnostic tools of oral rehabilitation treatments.

The results show that the ratios R2 and R3 increased after prosthodontic treatment due to increase of the segment Or-Me. Considering in the first radiography that the patient was in a rest position and in the second, with complete denture in occlusion with the new vertical dimension, was

Table 1. Results of Student's t-test.

	Ratio	Mean (mm)	Standard Deviation	t	P
Before Complete Dentures	1-Or-Me / Co-Go	1.570	0.137	1.936	0.03
	2-Or-Me / Ena-Enp	1.683	0.196	1.817	0.04
	3-Or-Me / N-Ena	1.734	0.117	5.444	>0.001
	4-Op-N / Or-Me	1.585*	0.111	1.641	0.06*
	5-N-Me / Ena-Me	1.746	0.070	10.049	>0.001
	6-Pog-Op/Or-Me	1.575*	0.141	1.682	0.05*
	7-Pog-Op / Enp-Op	1.755	0.103	7.251	>0.001
After Complete Dentures	1-Or-Me / Co-Go	1.598*	0.157	0.708	0.24*
	2-Or-Me / Ena-Enp	1.761	0.170	4.590	>0.001
	3-Or-Me / N-Ena	1.788	0.093	10.022	>0.001
	4-Op-N / Or-Me	1.531	0.081	5.864	>0.001
	5-N-Me / Ena-Me	1.707	0.060	8.107	>0.001
	6-Pog-Op/Or-Me	1.541	0.099	4.278	>0.001
	7-Pog-Op / Enp-Op	1.734	0.084	7.571	>0.001

* Not significant different of 1.618 ($P>.05$).

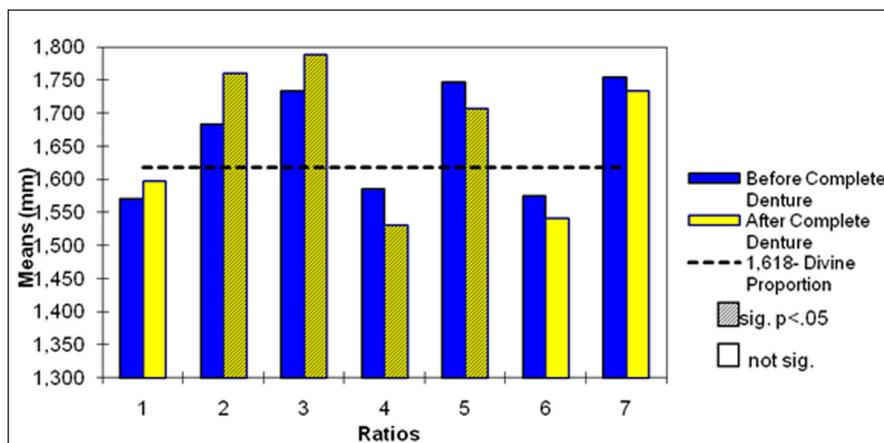


Fig. 2. Means of ratios (mm), before and after complete dentures.

observed that the occlusal vertical dimension was higher than the rest position of mandible.

One of the biggest problems in complete dentures is the lack of reproducible structures reference that determines the position of the guidance plan and the vertical dimension of occlusion. However, cephalometric analyzes may assist in verification of these positions during the treatment with complete dentures, in the vertical and horizontal planes (10-15).

The R5 (N-Me/Ena-Me), as shown in Figure 2, besides presenting statistically significant difference before and after treatment with complete dentures, it also approached of the divine proportion. This ratio relates two important segments, the total anterior facial height (N-Me) and the lower anterior facial height (Ena-Me), essential for the verification of the facial harmony. The dependent relationship between the vertical dimension of occlusion and facial height is the key for facial proportion improvement (7,16,17).

Thus is unquestionable the importance of the divine proportion, not only as a mathematical key to obtain beauty

and harmony, but as an auxiliary tool in the trial for the performance of others kinds of treatment, such as restorative dental, surgical, orthodontic or prosthodontic treatment.

Conclusions

The ratios orbitale-menton/anterior nasal spine-posterior nasal spine, orbitale-menton/nasion-anterior nasal spine, opisthion-nasion/orbitale-menton and nasion-menton/anterior nasal spine-menton were statistically significant different, before and after prosthodontic treatment.

There were no statistically significant difference in ratios orbitale-menton/condillion-gonion, pogonion-opisthion/orbitale-menton and pogonion-opisthion/posterior nasal spine-opisthion, before and after prosthodontic treatment.

The ratio nasion-menton/anterior nasal spine-menton that relates two important segments, the total anterior facial height and the lower anterior facial height, was closer to the golden number after prosthodontic treatment with complete dentures.

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