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Fernando Marques Barbosa Porfírio

PARÂMETROS ANATÔMICOS ÓSSEOS PARA POSICIONAMENTO DE DENTES SUPERIORES ANTERIORES ARTIFICIAIS

Belo Horizonte
2015

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Dissertação apresentada ao Programa de Pós-graduação em Odontologia da Pontifícia Universidade Católica de Minas Gerais, como requisito parcial para obtenção do título de Mestre em Odontologia - Área de Concentração: Clínicas Odontológicas, Área Temática: Prótese Dentária.

Orientador: Prof. Dr. Paulo Isaias Seraidarian
Coorientador: Prof. Dr. Paulo Franco Taitson

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Orientador

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RESUMO

Após a perda dos dentes anteriores superiores, o rebordo alveolar sofre um processo de remodelação que, invariavelmente, interfere no posicionamento dos tecidos moles adjacentes. Observa-se que a reposição dos dentes superiores artificiais anteriores, via de regra, é executada, com base em referências anatômicas dos tecidos moles, intra e extra orais, também alterados. Propõe-se nesse estudo determinar mensurações que se baseiam exclusivamente em tecidos ósseos, embriologicamente estáveis e relacionar estes acidentes anatômicos com a posição dos dentes anteriores superiores naturais, presentes em crânios secos, totalmente dentados, identificados e classificados. A amostra do estudo, composta por 60 crânios pertencentes ao Departamento de Ortodontia da Faculdade de Odontologia da Universidade Federal da Bahia, foi avaliada por 2 avaliadores calibrados e independentes, em momentos distintos, por meio de paquímetro digital (*Mitutoyo, Japão*). No grupo avaliado de 25 crânios femininos e 35 crânios masculinos, com idades, no momento da morte, entre 16 e 64 anos e média de idade de 28, 5 anos ± 12,3, a distância média do forame incisivo (FI) à parede vestibular dos incisivos maxialres foi de 15,16 mm ± 2,09 mm e margem de erro de 0,14 mm (nível de confiança de 99%). Concluindo, as mensurações realizadas a partir das referências anatômicas pospostas se mostraram constantes e confiáveis, independente da faixa etária e sexo do indivíduo.

Palavras-chave: Prótese dentária. Planejamento de prótese dentária. Referências anatômicas.

ABSTRACT

Upper front teeth absence, leads the maxilla alveolar ridge through a remodeling process that invariably interferes with the positioning of adjacent soft tissue. Majority replacement of upper front teeth is performed applying intra and extra oral soft tissue anatomical landmarks, which commonly undergone anatomic changes. The aim of this study was to determine measurements based exclusively on embryological stable bone tissues and relate these anatomical accidents to the positions of natural upper front teeth, present in dry, classified, and fully dentate skulls. Study sample comprised 60 skulls from the Department of Orthodontics of the Faculty of Dentistry, Federal University of Bahia. Two calibrated and independent appraisers evaluated all the skulls, at different times, via digital calipers (Mitutoyo, Japan). The group evaluated 25 female and 35 male skulls, aged 16 to 64 years with an average age of 28 years. The average distance from the incisive foramen (IF) to the vestibular surface of the upper incisors was 15.16±2.09 mm (level of confidence: 99%). We concluded that postponed measurements taken from anatomical landmarks proved steady and reliable, guiding the repositioning of previous artificial upper teeth independent of the patient's age group and sex.

Keywords: Dental prosthesis. Dental prosthesis design. Anatomic landmarks.

SUMÁRIO

1 INTRODUÇÃO

A necessidade de reposição protética dos dentes anteriores superiores é um problema tão antigo quanto a própria odontologia, no entanto, a recolocação em posições precisas continua sendo desafiante. A busca por referências no reposicionamento dos dentes artificiais remete aos povos egípcios, etruscos e fenícios (JOHNSON, 1959). Em vista do problema, parâmetros anatômicos confiáveis são essenciais para planejar a reconstrução dos contornos faciais (SUTTON et al., 2004).

O rebordo alveolar maxilar sofre intenso processo de reabsorção após perdas dentárias, com remodelação óssea que ocorre previsivelmente e fisiologicamente no sentido palatino e apical (SUTTON et al., 2004). O edentulismo na região anterior da maxila leva diretamente à perda de suporte labial com inevitáveis alterações estéticas e fonéticas (KAMASHITA et al., 2006).

A reposição protética, tanto do tecido ósseo como do tecido mole, perdidos durante o processo de remodelação óssea, é diretamente dependente do posicionamento tridimensional dos dentes anteriores superiores artificiais (KAMASHITA et al., 2006).

Diante deste fato, a utilização de pontos de referência em tecido mole foi extensamente descrita na literatura, sendo a papila incisiva um dos principais (PARK; LEE; PAIK, 2007; OH; HANSEN, 2009; BAKER et al., 2011; ISA; ABDULHADI, 2012; CHUNG; PARK; SHON, 2014). Em indivíduos com anatomia normal a papila incisiva recobre o forame incisivo, é localizada na linha mediana, atrás aos incisivos centrais superiores e tem seu posicionamento anatômico constante (KARTHIGEYAN et al., 2012; AL-AMERY et al., 2015). No entanto, não é raro encontrar papilas na face vestibular de rebordos alveolares que sofreram reabsorção extensa. Observa-se então, que parâmetros voltados para a papila incisiva, que sabidamente sofre alterações morfológicas, não são precisos e estáveis para auxiliar no posicionamento dos dentes anteriores artificiais, em rebordos alveolares reabsorvidos (SOLOMON; ARUNACHALAM, 2012).

O forame incisivo, é uma estrutura anatômica que está presente até em rebordos com extensa reabsorção óssea (MARDINGER et al., 2008), não apresenta variações significativas entre dentados e desdentados (LIANG et al., 2009) com uma única abertura na região maxilar anterior, mediana e posterior aos incisivos centrais superiores (SONG et al., 2009).

É fato inegável que com o advento dos implantes osseointegrados a tomografia odontológica ganhou nova dimensão. Diante desta constatação e pelo fato do forame incisivo ser perfeitamente identificável e ter sua posição passível de ser mensurada com exatidão, uma vez que esta imagem não tem distorção, este acidente anatômico passa a ser relevante como referência no posicionamento dos dentes incisivos superiores artificiais.

Denomina-se pré-maxila a região triangular, delimitada anteriormente pela parede anterior do processo alveolar e posteriormente pelo forame incisivo, que contém os quatro dentes incisivos. É a primeira porção do palato a se fusionar, ainda na sétima semana de vida uterina, sendo uma área de grande resistência e estabilidade no adulto, com regularidade de crescimento e com poucas variações durante seu desenvolvimento, corroborando a ideia de constância morfológica da região (DELAIRE, 1974; FRIEND et al., 1990).

Em vista da escassez de dados que tenham como base estruturas anatômicas embriologicamente estáveis, identificou-se a necessidade de estabelecer referências confiáveis, a partir de crânios secos totalmente dentados, identificados e classificados como Classe I de Angle (GULDAG; SENTUT; BUYUKKAPLAN, 2008). Desta forma objetivou-se obter dados no sentido de restabelecer a morfologia de maxilas que sofreram reabsorções, colaborando com o estabelecimento de parâmetros anatômicos ósseos confiáveis, a partir do forame incisivo, que permita o reposicionamento adequado dos dentes artificiais anteriores superiores.

2 OBJETIVOS

2.1 Objetivo geral

Estabelecer parâmetros anatômicos, em estruturas ósseas estáveis, não susceptíveis à reabsorção, de crânios secos dentados, identificados, classificados como Classe I de Angle para orientação do posicionamento dos dentes artificiais anteriores superiores artificiais, em próteses na região anterior de maxila.

2.2 Objetivos específicos

a) estabelecer a distância da face vestibular dos incisivos centrais superiores à parede posterior do forame incisivo;
b) estabelecer a distância da parede posterior do forame incisivo até a porção mais distal da espinha nasal posterior;
c) estabelecer a largura dos incisivos centrais superiores;
d) a partir da identificação das medidas, avaliar a existência de correlação entre elas;
e) a partir da identificação das medidas, avaliar a existência de diferenças entre crânios do sexo masculino e feminino;
f) a partir da identificação das medidas, avaliar a existência de diferenças entre crânios de diferentes idades.

3 MATERIAL E MÉTODOS

Para que a presente pesquisa pudesse ser realizada, inicialmente realizou-se contato com o Departamento de Ortodontia da Universidade Federal da Bahia, com intuito de obter autorização para manipular a coleção de crânios pertencentes ao referido Departamento. Uma vez obtida a autorização, o próximo passo foi encaminhar o projeto de pesquisa ao Comitê de Ética em Pesquisa (PLATAFORMA BRASIL) que recebeu aprovação sob número 50195115.0.0000.5137.

Agora, no que tange à pesquisa propriamente dita, viajou-se para Salvador para dar início às mensurações que passam a ser descritas. O acervo do Departamento de Ortodontia da UFBA é composto por um grupo de 62 crânios secos (Quadro 1).

Os critérios de inclusão estabelecidos no presente estudo foram que as peças deveriam ser identificadas, com *causa mortis*, presença de todos os dentes, com padrão oclusal classificado como Classe I de Angle e ausência de qualquer patologia óssea na região da maxila. Diante do exposto e após exame dos crânios dois exemplares foram excluídos, por não estarem de acordo com os critérios propostos (Quadros 1 e 2).

3.1 Mensurações

Antes do início do estudo, um protocolo detalhado de pesquisa foi extensamente discutido. As medições foram realizadas por 2 observadores independentes, previamente calibrados. As mensurações foram obtidas por meio de um paquímetro digital (*Mitutoyo, Japão*). Todas as medidas foram realizadas com precisão de 0,01mm. O primeiro observador efetuou as medições em todos os 60 exemplares da amostra selecionada. O segundo observador, que não participou em nenhum momento da primeira medição, efetuou as medições em 20 crânios (33,33% da primeira etapa), 2 dias após o primeiro observador. As mensurações foram realizadas seguindo os seguintes marcos anatômicos:

a) a distância, em milímetros (mm), da face vestibular dos incisivos centrais superiores (VIC) à parede posterior do forame incisivo (IF), doravante denominada de medida A (Fig. 1);

Figura 1: Medida A

Fonte: Elaborado pelo autor

b) a distância, em milímetros (mm), da parede posterior do forame incisivo (FI) até a porção mais distal da espinha nasal posterior (ENP), doravante denominada de medida B (Fig. 2);

Figura 2: Medida B

Fonte: Elaborado pelo autor

c) a largura, em milímetros (mm), dos incisivos centrais superiores (LIC), doravante denominada de medida C (Fig. 3).

Figura 3: Medida C

Fonte: Elaborado pelo autor

Para a padronização das medidas 1 e 2, a sutura palatina foi utilizada como referência pelos observadores no alinhamento do paquímetro. Para a medida 3, a referência utilizada foram os pontos de maior equador dentário dos dentes avaliados.

Quadro 1: Amostra inicial

Amostras com 62 (sessenta e dois) crânios humanos					
Nº	Identificador	Idade (anos)	Dimensões (mm)		
			A	B	C
1	07 F	18	18,01	37,73	17,08
2	16 F	18	11,46	42,96	15,86
3	23 F	19	14,79	43,77	16,66
4	26 F	23	15,02	43,34	16,03
5	37 F	27	12,15	39,29	14,91
6	45 F	45	17,08	38,95	16,32
7	54 F	23	15,08	47,02	15,18
8	58 F	27	14,22	39,93	18,22
9	66 F	26	19,38	41,23	17,55
10	74 F	18	12,50	43,26	15,05
11	79 F	23	14,05	43,22	16,58
12	80 F	18	16,60	39,10	16,61
13	84 F	45	16,47	45,41	16,97
14	88 F	21	15,37	42,28	16,05
15	92 F	24	16,02	40,38	17,95
16	101 F	31	17,44	41,30	17,90
17	104 F	23	14,98	40,07	15,85
18	106 F	29	14,62	44,55	15,95
19	108 F	22	19,33	39,35	16,64
20	140 F	32	15,21	44,57	18,78
21	142 F	16	12,27	33,40	15,83
22	143 F	17	15,60	37,38	18,19
23	152 F	22	17,55	44,40	18,84
24	171 F	32	14,88	38,00	17,43
25	09 M	26	16,17	42,57	16,30
26	13 M	21	16,60	39,07	16,62
27	19 F	21	14,89	42,64	15,96
28	21 M	22	14,03	37,34	18,01
29	24 M	19	15,48	48,47	15,54
30	29 M	32	13,46	40,90	17,31
31	31 M	31	14,92	39,49	Frat. Inc.
32	34 M	40	17,60	41,87	16,90
33	36 M	36	14,64	42,67	17,15
34	39 M	18	16,32	43,87	17,91
35	40 M	18	14,87	37,71	16,90
36	41 M	64	16,47	42,39	16,28
37	47 M	52	12,54	43,04	16,48
38	49 M	20	14,11	38,09	Aus. 11
39	50 M	21	16,80	43,52	16,87
40	51 M	20	12,76	40,93	15,04
41	57 M	19	16,02	40,54	16,89
42	60 M	60	14,91	41,91	18,31
43	68 M	25	15,60	42,35	17,32
44	91 M	19	13,62	43,96	17,02
45	99 M	20	14,01	43,81	15,89
46	111 M	33	14,95	47,05	19,49
47	113 M	34	12,27	42,77	16,62
48	114 M	24	16,33	44,61	17,44
49	116 M	22	9,47	45,65	16,91
50	118 M	19	16,84	37,26	18,73
51	123 M	23	19,90	44,34	15,55
52	131 M	48	15,44	41,33	17,95
53	134 M	19	15,19	36,92	17,77
54	135 M	29	12,96	42,20	16,70
55	138 M	63	13,90	44,06	15,42
56	144 M	24	12,49	44,55	16,61
57	149 M	52	13,17	45,67	17,19
58	159 M	32	15,82	44,83	16,47
59	164 M	28	12,21	42,84	17,72
60	180 M	55	15,54	44,52	16,63
61	173 M	17	16,76	37,96	16,10
62	71 M	35	19,55	43,86	18,15

Quadro 2: Amostra final

Amostras com 60 (sessenta) crânios humanos					
Nº	Identificador	Idade (anos)	Dimensões (mm)		
			A	B	C
1	07 F	18	18,01	37,73	17,08
2	16 F	18	11,46	42,96	15,86
3	23 F	19	14,79	43,77	16,66
4	26 F	23	15,02	43,34	16,03
5	37 F	27	12,15	39,29	14,91
6	45 F	45	17,08	38,95	16,32
7	54 F	23	15,08	47,02	15,18
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10	74 F	18	12,50	43,26	15,05
11	79 F	23	14,05	43,22	16,58
12	80 F	18	16,60	39,10	16,61
13	84 F	45	16,47	45,41	16,97
14	88 F	21	15,37	42,28	16,05
15	92 F	24	16,02	40,38	17,95
16	101 F	31	17,44	41,30	17,90
17	104 F	23	14,98	40,07	15,85
18	106 F	29	14,62	44,55	15,95
19	108 F	22	19,33	39,35	16,64
20	140 F	32	15,21	44,57	18,78
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45	113 M	34	12,27	42,77	16,62
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47	116 M	22	9,47	45,65	16,91
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50	131 M	48	15,44	41,33	17,95
51	134 M	19	15,19	36,92	17,77
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59	173 M	17	16,76	37,96	16,10
60	71 M	35	19,55	43,86	18,15

Fonte: Elaborado pelo autor

3.2 Análise estatística

A distribuição normal foi verificada pelo Teste de Lilliefors, sendo que os resultados verificaram a normalidade de todos os grupos amostrais. Em seguida, o Teste t pareado foi realizado com o intuito de avaliar o grau de concordância entre os avaliadores.

O teste de correlação de Pearson foi aplicado com o intuito de avaliar a existência de correlação entre as mensurações obtidas.

Com o objetivo de avaliar se a diferença entre os sexos e diferentes faixas etárias interfeririam nos resultados das medidas desse estudo, foi a aplicada a Análise de Variância (ANOVA) para dois fatores.

De posse desses dados, os mesmos foram analisados por meio do Minitab® 17 Statistical Software, interpretados e os resultados passam a ser descritos.

4 ARTIGO

ANATOMY BONE PARAMETERS FOR ANTERIOR SUPERIOR ARTIFICIAL TEETH POSITIONING

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ANATOMY BONE PARAMETERS FOR ANTERIOR SUPERIOR ARTIFICIAL TEETH POSITIONING

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ABSTRACT

Upper front teeth absence, leads the maxilla alveolar ridge through a remodeling process that invariably interferes with the positioning of adjacent soft tissues. Majority artificial replacement of upper front teeth is performed applying intra and extra oral soft tissue anatomical landmarks, which commonly undergone anatomic changes. The aim of this study was to determine measurements based exclusively on embryological stable bone tissues and relate these anatomical accidents to the positions of natural upper front teeth, present in dry, classified, and fully dentate skulls. Study sample comprised 60 skulls from the Department of Orthodontics of the Faculty of Dentistry, Federal University of Bahia. Two calibrated and independent appraisers evaluated all the skulls, at different times, via digital calipers (*Mitutoyo*, Japan). The group evaluated 25 female and 35 male skulls, aged 16 to 64 years with an average age of 28 years. The average distance from the incisive foramen (IF) to the vestibular surface of the upper incisors was 15.16±2.09 mm (level of confidence: 99%). We concluded that postponed measurements taken from anatomical landmarks proved steady and reliable, guiding the repositioning of previous artificial upper teeth independent of the patient's age group and sex.

Keywords: Dental prosthesis. Dental prosthesis design. Anatomic landmarks.

INTRODUCTION

Prosthetic replacement of the upper anterior teeth is a problem as old as dentistry itself; however, the precise replacement itself remains a challenge. The Egyptians, Etruscans and Phoenícians[15] all engaged in repositioning artificial teeth[15]. Reliable, anatomical parameters are essential to plan the reconstruction of face contours[29].

The upper maxillary alveolar ridge suffers from intense resorption after tooth loss with bone remodeling that occurs predictably and physiologically in the palatine and apical directions[29]. Dental and bone support loss in the anterior upper maxillary region leads directly to the loss of lip support, and aesthetic and phonetic changes are inevitable[16].

Prosthetic replacement of both bone tissue and soft tissue lost during the process of bone remodeling is directly dependent on three-dimensional positioning of the artificial upper anterior teeth[16].

Given this fact, the use of landmarks in soft tissue has been extensively described in the literature, with the incisive papilla as a main[3,7,13,24,25]. In subjects in which an incisive papilla with normal anatomy covers the incisive foramen (IF), the papilla is located on the midline, behind the upper central incisors and has a constant anatomical position[2,18]. However, it is common to find papillas on the buccal aspect of alveolar ridges that suffer from extensive resorption. In these cases, parameters estimated using the incisive papilla as a reference, which are known to suffer from morphological changes, are neither precise nor stable; these parameters cannot be used to assist in positioning the artificial anterior teeth in reabsorbed alveolar ridges[27].

The IF is an anatomical structure that is present even at ridges with extensive bone resorption[20], it does not vary between toothed and toothless individuals[19]. The IF contains a single opening in the anterior maxillary region, median and posterior to the maxillary central incisors[28].

It is an undeniable fact that given the advent of dental implants, tomography in dentistry has been elevated to new levels of importance. Because the IF is perfectly identifiable with a position that can be measured accurately without distortion, this anatomical accident is now relevant as a reference point for positioning artificial superior incisors.

In the upper maxillary bone, a triangular region delimited anteriorly by the anterior wall of the alveolar process and subsequently the incisor foramen, which contains the four incisors, is called the pre-maxilla. It is the first portion of the palate to fuse in the seventh week of uterine life. Being an area of high strength and stability in adults, with regular growth and with few variations during its development, it supports the idea of morphological constancy of region[8,10].

Given the paucity of data that are embryological based, stable anatomical structures, we identified the need to establish reliable references from fully toothed dry skulls identified

and classified as Class I Angle[12]. Our goal was to obtain data in order to restore the morphology of upper maxillary bone that has undergone resorption. We expect that our work will contribute to establishing reliable bony anatomical parameters from the IF to enable proper repositioning of maxillary anterior artificial teeth.

MATERIAL E METHODS

Initially, we contacted the Federal University of Bahia Orthodontics Department, Salvador, Brazil, in order to obtain authorization to handle the Department's collection of dry skulls. The research project was initially submitted to the Research Ethics Committee (PLATFORM BRAZIL) and received approval under number 50195115.0.0000.5137.

The initial sample included 62 dry skulls. Inclusion criteria in this study were that skulls should be identified with the cause of death and that they should retain all of their teeth. We also required an occlusal pattern classified as Class I Angle and the absence of any bone pathology in the upper maxillary region. After examining the sample, two skulls were excluded because they were not in accordance with the inclusion criteria.

Measurements

A detailed research protocol was widely discussed prior to the start of the study. The measurements, performed by two independent observers, were previously calibrated directly on the dry skulls using digital calipers (Mitutoyo, Japan). All of the steps were performed with an accuracy of 0.01 mm. The first observer measured all 60 skulls in the sample. The second observer, who did not participate in any time during the first stage, measured 20 skulls (33.33% of the first stage) two days after the first observer. The measurements were performed according to the following anatomical landmarks:

1. The distance in millimeters between the labial surface of the maxillary central incisors (VIC) to the posterior wall of the IF, hereinafter referred to measurement A (Figure 1);
2. The distance in millimeters between the posterior wall of the IF to the distal portion of the posterior nasal spine (ENP), hereinafter referred to a measurement B (Figure 2);
3. The width in millimeters of the upper central incisors (LIC), hereinafter referred to as measurement C (Figure 3).

The palatine suture was used as a standardized reference for aligning calipers for measurements A and B. For measurement C, we used the points of greatest dental equator of the examined teeth as reference points.

Statistical analysis

We checked the data for a normal distribution using the Lilliefors test, and the results verified the normality of all sample groups. Next, we used a paired *t*-test to evaluate the degree of agreement among raters.

We applied the Pearson correlation test to assess whether there was a correlation between the measurements that we obtained.

With the goal of evaluating if different ages or sexes interfered with the results of the measurements, we applied two-factor analysis of variance (ANOVA).

We analyzed the data using Minitab 17 Statistical Software.

RESULTS

Descriptive analysis

The final sample consisted of 60 dry skulls (25 women and 35 men; Table 1) with ages at the time of death between 16 and 64 years and a mean age of 28.4 ± 12.3 years. We remind the reader that two skulls of the original group were excluded because they did not satisfy the inclusion criteria. We estimated the mean, standard deviation (SD) and coefficient of variation for all samples with a confidence index (CI) of 95% (Table 2). Our analysis of the coefficients of variation revealed that all dimensions were homogeneous (< 0.25 or < 25%).

We present descriptive results by separating the skulls into the following groups: younger than 21 years, 22–30 years, older than 30 years, females, males. The samples were divided into five groups called G 1 (n = 21), composed of skulls of individuals who died below the age of 21; G 2 (n = 20), composed of skulls of individuals who died in the age range of 22–30; and G 3 (n = 19), composed of skulls of individuals who died older than 30. In terms of gender, we created two additional groups: G 4 (n = 25), composed of skulls belonging to females and G 5 (n = 35), composed of skulls belonging to males (Tables 3 and 4).

The first measurements that we obtained were analyzed separately in order to evaluate the homogeneity of the total sample (Table 1). To validate the mean of an anatomical dimension, we calculated the interval estimate, which is nothing more than a range of values used to estimate a population parameter. Based on data, it can be stated that the average of the measured distances will be present in ranges of values obtained in 99% of cases. Within the measured values, measurement A exhibited four unusual values (between 1 and 2 SDs), measurement B exhibited two unusual values and measurement C exhibited only one unusual value. Any value more than 2 SD discrepant from the mean was very unusual, a fact that confirms the homogeneity of the sample.

Linear correlation

Since the three measurements were obtained in the same unit, it was important to verify the correlation among them in order to combine the results of the three measurements or analyze them separately. When the A, B and C measurements were continuous variables, we applied the Pearson correlation test (Square 1).

Whereas there was no correlation between the measurements A and B and between measurements B and C and only a weak correlation between measurements A and C, we examined the variables separately.

Inter-observer agreement

To test the quality of the measurements, the data were re-collected by a second evaluator for 20 skulls (33.33%) in the sample. Given the continuous quantitative nature of these measurements, we expected slight differences. We accordingly tested whether these differences were significant or not.

We applied a paired *t*-test to assess whether the measurements were significantly different. If the p value exceeded 0.05, we decided that that the measurements were not statistically different (i.e., there was agreement among raters) (Table 5).

Since all of the p values that we calculated exceeded 0.05, we concluded that there was no significant difference among the measurements (i.e., there was agreement among the raters).

Age group and sex influence

The aim of this analysis was to assess whether age and sex were correlated with the measurements of interest.

Since we did not identify any p value greater than 0.05 for any factor in any of the measurements, we can conclude that the factors did not interfere with the results of the measurements (Tables 6, 7 and 8).

DISCUSSION

Given that the position of artificial upper front teeth sets aesthetic, phonetic and functional patterns[16], determining their proper position is essential for constructing conventional and implant prostheses[25].

Previously the facial contours of edentulous patients offered only indirect indicative positioning of artificial anterior superiors teeth[25]; the use of references, such as the smile line and the distance between the mouth corners exhibits significant variation and does not always indicate better positioning of artificial teeth[21].

The incisive papilla, a widely used anatomical reference, is located in the midline of the palate behind the central incisors[2,3,13,18,25,31], and its anatomical position is relatively constant with the exception of resorbed ridges. In such cases, the incisive papilla has been shown to exhibit relevant anatomical changes and significant variations in its position in relation to the remaining ridge[11,14,21,31].

The literature has noted that more stable parameters that do not involve soft tissues are required for precise prosthetic rehabilitations. Therefore, the positioning of the artificial anterior superior segment should be set following stable and reliable anatomical landmarks[10,11,18].

The IF is a bony anatomical structure present in the anterior maxilla, located in the bone junction of the two maxilla bone sides, subsequently to the maxillary central incisors[20,23]. This anatomy has been poorly documented, and the increased use of implants in the anterior maxilla has piqued researchers' interests in the nasopalatine channel within the last decade[12,23]. After examining the anatomy of the nasopalatine canal using computed tomography (CT), the lower orifice, called the IF, always exhibited only a single communication cleft. The anatomical stability of the IF justifies its use in other studies such as morphological evaluations of palatine sutures[26] as an anatomical reference in anesthesia innervation coming from the palatal foramen[6], facial growth assessments[22] and spatial orientation of upper incisor implant replacement[5].

Kang et al.[17] (2012) attempted to establish oral cavity anatomical structures to locate the palatal foramen, and these authors reported linear distances between the front teeth and the foramen in question. However, Kang et al. did not provide data pertaining to the IF. These authors questioned the use of dry skulls due to the fact that the sample was not sex identified. It is known that linear direct measurements in dry skulls are easily accessible and reliable; however, angular measurements are difficult to implement and are characterized by a low level of accuracy. We did no attempt to classify the deficiencies, sex or history of the skulls in this study, despite the sample being fully classified and identified.

Mraiwa et al.[23] (2004) studied a skull sample of 34 CT scans and found no effect of gender, age or the presence or absence of teeth on the anatomy of the nasopalatine channel, including the IF. These findings are consistent with what we recovered in our own investigation. However, Mraiwa et al. reported that other studies with more bulky samples should be performed to assess the influence of these factors. It is noteworthy that the sample size of this study sample was almost twice as large as Mraiwa et al.

Liang et al.[19] (2009), Song et al.[28] (2009), Tozun et al.[30] (2012), Guncu et al.[12] (2013), Etoz et al.[9] (2014) and Acar et al.[1] (2015) found no statistical differences in the anatomy of the IF when they compared toothed and edentulous samples. Conversely, Mardinger et al.[20] (2008) observed an enlarged incisive canal measuring on average 1.8 mm after the loss of

teeth ; its back wall was not significantly affected by this process. It is noteworthy that the result was obtaining using a heterogeneous sample in which no pairing for comparison of anatomical changes was conducted. Therefore, the findings recovered can only be considered to be a variation of the evaluated structure.

Acar et al.[1] (2015) observed that the IF exhibited no statistical differences in terms of sex, age or the absence or presence of the central incisors. A small increase in the IF in males was observed (a 3.96–3.79mm difference). Tozum et al.[30] (2012) and Al- Amery et al.[2] (2015) observed differences between males and females in the IF and the dimensions of the remaining buccal bone in edentulous patients. However, these authors failed to identify a significant difference according to age.

In order to contribute to better positioning of artificial anterior teeth superiors, one embryological stable reference seems to be in the best course of action for completing a prosthetic treatment. The current literature presents data that support the morphological stability of the IF between dentate and edentulous patients[1,9,19,23,28] , and biometric and linear measurements related to this anatomical landmark have proven to be safe and reliable.

This study included a significant sample size that yielded standardized and homogenous average values: measurement A = 15.16 ± 2.09 *mm*, measurement B = 42.01 ± 2.93 *mm* and measurement C = 16.88 ± 1.03 *mm* with a 99% confidence level. When different age groups were evaluated using analysis of variance (α = 0.05), the averages were statistically regular, and age alterations did not significantly affect the obtained measurements. When we compared males and females using analysis of variance (α = 0.05), the averages were statistically regular, and sex did not interfere significantly with the measurements that we obtained.

The results of previous studies have revealed the morphological constancy of the IF and the lack of influence of age and sex of the samples[1,2,23,30,]. This finding was manifested in this study based on the high level of consistency obtained from measurement A.

Especially important in terms of the objectives of this study, measurement A exhibited widely uniform and constant results for all groups (Table 9).

It is noteworthy that we did not carry out comparisons between our findings and other similar studies in the literature because it was not possible to identify studies with similar goals.

Our proposal to obtain new parameters for positioning artificial maxillary anterior teeth based on mean values between two stable points on hard tissues proved to be possible since the observed means exhibited a high level of confidence (99%) and a lack of sex- and age-related changes.

Because our sample is non-probabilistic covering only a specific origin, age and sex profile, one must be careful when generalizing our findings to larger populations. Studies with larger sample sizes and greater variation in profile are required. However, the linear

measurements obtained in this study revealed constant average values, even for samples that differed in terms of age and sex. Therefore, we can concluded that these measurements are reliable and stable and can be applied for orienting the three-dimensional position of artificial anterior maxillary teeth and accordingly achieving more accurate results in prosthetic dentures.

CONCLUSIONS

Based on our intent to establish anatomical parameters based on stable bone structures, we were able to achieve this objective. In addition to analyzing and comparing measurements A, B and C, it was also possible to verify a correlation between previously measured dimensions. Although we did not observe a significant correlation between distances, these data exhibited constants means independent of sex and age. They are reliable and stable to guide three-dimensional positioning of superior anterior artificial teeth and consequently achieve accurate results for prosthetics rehabilitations.

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FIGURE LIST

Figure 1 - Measurement A

Figure 2 - Measurement B

Figura 3 - Measurement C

SQUARE LIST

Square 1 - Pearson correlation test

Variable	Correlation coeficient
A e B	-0,094
A e C	0,253
B e C	-0,086

TABLE LIST

Table 1 - Gender distribution

Gender	Sample	Nº (%)
Female	25	41,7%
Male	35	58,3%
Total	60	100,0%

Table 2 - Measurements A, B e C description

Statistic	Measurement A	Measurement B	Measurement C	Age
Mean (mm)	15,161	42,015	16,876	28,483
Standard deviation (SD)	2,085	2,9326	1,0311	12,2923
Coefficients of variation(CV)	0,137524	0,069799	0,061099	0,431566
CI 95%	(14,6 ; 15,7)	(41,3 ; 42,8)	(16,6 ; 17,1)	(25,3 ; 31,7)

Table 3 - Age groups measurements A, B e C description

Statistic	Measurement A	Measurement B	Measurement C
	G 1 – Up to 21 years		
Mean (mm)	15,084	40,788	16,599
Standard deviation (SD)	1,7537	3,5132	0,9842
Coefficients of variation(CV)	0,116262	0,086133	0,059293
	G 2 - 22 - 30 years		
Mean (mm)	15,078	42,462	16,813
Standard deviation (SD)	2,6399	2,4826	1,0615
Coefficients of variation(CV)	0,175083	0,058466	0,063136
	G 3 – Older than 30 years		
Mean (mm)	15,334	42,900	17,250
Standard deviation (SD)	1,8520	2,2807	0,9886
Coefficients of variation(CV)	0,120777	0,053163	0,05731

Table 4 - Gender sample statistical description.

Statistic	Measurement A	Measurement B	Measurement C
		G 4 - Female	
Mean (mm)	15,399	41,341	16,736
Standard deviation (SD)	2,0635	3,0795	1,1265
Coefficients of variation(CV)	0,134002	0,07449	0,06731
		G 5 - Male	
Mean (mm)	14,991	42,495	16,977
Standard deviation (SD)	2,1135	2,7710	0,9614
Coefficients of variation(CV)	0,140985	0,065208	0,05663

Table 5 - Paired t-test

Measurements	Evalueators mean difference	T statistic	p-value
A	-0,09783	-0,807	0,428
B	-0,34652	-1,086	0,289
C	-0,03826	-0,445	0,661

Table 6 - Measurement A two factors ANOVA

Measurement A	F statistic	p-value
Origin (mean)	2.977,171	> 0,001
Gender	0,721	0,400
Age group	0,183	0,833

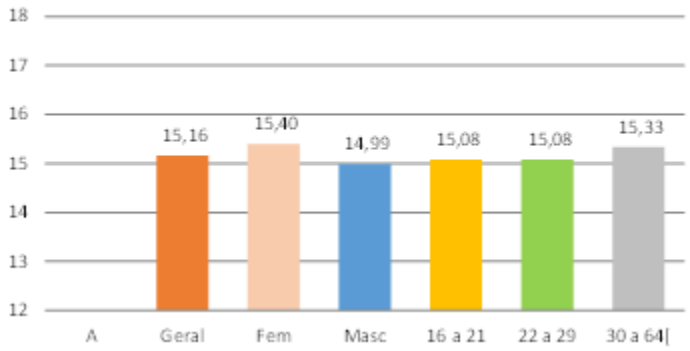
Table 7 - Measurement B two factors ANOVA

Measurement A	F statistic	p-value
Origin (mean)	12.972,092	> 0,001
Gender	2,112	0,152
Age group	3,029	0,056

Table 8 - Measurement C two factors ANOVA

Measurement C	F statistic	p-value
Origin (mean)	15.944,670	> 0,001
Gender	0,336	0,564
Age group	1,859	0,165

Table 9 - Measurement A mean



5 CONSIDERAÇÕES FINAIS

Por se tratar de amostra não-probabilística, abrangendo apenas um perfil específico, devemos ter cuidado ao generalizar os resultados aqui obtidos para a população em geral. Entretanto as medidas lineares obtidas nesse estudo mostraram médias constantes, mesmo em amostras de diferentes faixas etárias e sexo. Sendo assim, concluímos que elas são confiáveis e estáveis para serem aplicadas.

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