UNIVERSIDADE ESTADUAL DE CAMPINAS
FACULDADE DE ODONTOLOGIA DE PIRACICABA

GESOM AVÔHAI DIAS SOMBRA

# AVALIAÇÃO MORFOMÉTRICA DA SÍNFISE MANDIBULAR ASSOCIADA AO PERFIL DE TECIDO MOLE E DISPONIBILIDADE DE ENXERTO ÓSSEO AUTÓGENO EM TOMOGRAFIAS COMPUTADORIZADAS DE FEIXE CÔNICO

# MORPHOMETRIC EVALUATION OF THE MANDIBULAR SYMPHYSIS ASSOCIATED WITH SOFT TISSUE PROFILE AND AVAILABILITY OF AUTOGENOUS BONE GRAFT IN CONE BEAM COMPUTED TOMOGRAPHY

PIRACICABA
2023

**GESOM AVÔHAI DIAS SOMBRA**

# AVALIAÇÃO MORFOMÉTRICA DA SÍNFISE MANDIBULAR ASSOCIADA AO PERFIL DE TECIDO MOLE E DISPONIBILIDADE DE ENXERTO ÓSSEO AUTÓGENO EM TOMOGRAFIAS COMPUTADORIZADAS DE FEIXE CÔNICO

# MORPHOMETRIC EVALUATION OF THE MANDIBULAR SYMPHYSIS ASSOCIATED WITH SOFT TISSUE PROFILE AND AVAILABILITY OF AUTOGENOUS BONE GRAFT IN CONE BEAM COMPUTED TOMOGRAPHY

Dissertação apresentada à Faculdade de Odontologia de Piracicaba da Universidade Estadual de Campinas como parte dos requisitos exigidos para a obtenção do título de Mestre em Clínica Odontológica, na Área de Cirurgia e Traumatologia Buco-Maxilo-Faciais.

Dissertation presented to the Piracicaba Dental School of the University of Campinas in partial fulfillment of the requirements for the degree of Master in Dental Clinic, in Oral and Maxillofacial Surgery area.

Orientador: Prof. Dr. Alexander Tadeu Sverzut

ESTE EXEMPLAR CORRESPONDE À VERSÃO FINAL DA DISSERTAÇÃO DEFENDIDA PELO ALUNO GESOM AVÔHAI DIAS SOMBRA E ORIENTADA PELO PROF. DR. ALEXANDER TADEU SVERZUT.

PIRACICABA

2023

Ficha catalográfica
Universidade Estadual de Campinas
Biblioteca da Faculdade de Odontologia de Piracicaba
Marilene Girello - CRB 8/6159

Sombra, Gesom Avôhai Dias, 1997-
So52a Avaliação morfométrica da sínfise mandibular associada ao perfil de tecido mole e disponibilidade de enxerto ósseo autógeno em tomografias computadorizadas de feixe cônico / Gesom Avôhai Dias Sombra. – Piracicaba, SP : [s.n.], 2023.

Orientador: Alexander Tadeu Sverzut.
Dissertação (mestrado) – Universidade Estadual de Campinas, Faculdade de Odontologia de Piracicaba.

1. Tomografia computadorizada de feixe cônico. 2. Queixo. 3. Enxerto de osso alveolar. 4. Cefalometria. I. Sverzut, Alexander Tadeu, 1975-. II. Universidade Estadual de Campinas. Faculdade de Odontologia de Piracicaba. III. Título.

Informações Complementares

**Título em outro idioma:** Morphometric evaluation of the mandibular symphysis associated with soft tissue profile and availability of autogenous bone graft in cone beam computed tomography
**Palavras-chave em inglês:**
Cone-beam computed tomography
Chin
Alveolar bone grafting
Cephalometry
**Área de concentração:** Cirurgia e Traumatologia Buco-Maxilo-Faciais
**Titulação:** Mestre em Clínica Odontológica
**Banca examinadora:**
Alexander Tadeu Sverzut [Orientador]
Vitor José da Fonseca
Matheus Lima de Oliveira
**Data de defesa:** 30-03-2023
**Programa de Pós-Graduação:** Clínica Odontológica

**Identificação e informações acadêmicas do(a) aluno(a)**
- ORCID do autor: https://orcid.org/0000-0001-7567-4665
- Currículo Lattes do autor: http://lattes.cnpq.br/4012018318479930

**UNIVERSIDADE ESTADUAL DE CAMPINAS**
**Faculdade de Odontologia de Piracicaba**

A Comissão Julgadora dos trabalhos de Defesa de Dissertação de Mestrado, em sessão pública realizada em 30 de março de 2023, considerou o candidato GESOM AVÔHAI DIAS SOMBRA aprovado.

PROF. DR. ALEXANDER TADEU SVERZUT

PROF. DR. VITOR JOSÉ DA FONSECA

PROF. DR. MATHEUS LIMA DE OLIVEIRA

A Ata da defesa, assinada pelos membros da Comissão Examinadora, consta no SIGA/Sistema de Fluxo de Dissertação/Tese e na Secretaria do Programa da Unidade.

# AGRADECIMENTOS

A Deus, pela vida, bênçãos e por sempre estar presente em todos os aspectos da minha vida.

À Universidade Estadual de Campinas, em nome de seu Magnífico reitor Antonio José de Almeida Meirelles, pela oportunidade de formação na Pós-Graduação.

À Faculdade de Odontologia de Piracicaba, em nome de seu diretor Prof. Dr. Flávio Henrique Baggio Aguiar.

À Coordenadoria Geral dos cursos de Pós-Graduação da FOP – UNICAMP, em nome do Prof. Dr. Valentim Adelino Ricardo Barão.

À Coordenadoria do Programa de Pós-Graduação em Clínica Odontológica, em nome do Prof. Dr. Valentim Adelino Ricardo Barão.

O presente trabalho foi realizado com apoio do Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), processo nº 130518/2021-2.

À área de Cirurgia Buco-Maxilo-Facial da FOP – UNICAMP, em nome do Prof. Dr. Márcio de Moraes, pela excelente infraestrutura na formação profissional e acadêmica.

Ao meu orientador Prof. Dr. Alexander Tadeu Sverzut, pela conhecimentos teóricos e práticos compartilhados, pela confiança e oportunidade oferecidas visando o meu crescimento acadêmico e profissional, sendo sempre muito solícito em todas as demandas, pela convivência e pela orientação neste trabalho.

Aos professores da área de Cirurgia Buco-Maxilo-Facial da FOP – UNICAMP, em nome da Profa. Dra. Luciana Asprino e Prof. Dr. Márcio de Moraes, por todas as orientações e conselhos, seja no atendimento clínico aos pacientes, no ambiente da graduação e/ou na vida pessoal. Sou grato por todas as oportunidades oferecidas e principalmente, por me permitirem estar em um ambiente onde a relação e o convívio permanecem sempre de forma harmoniosa e respeitosa.

Às secretárias da área de Cirurgia Buco-Maxilo-Facial da FOP – UNICAMP, em nome de Luciana Apª Simom de Camargo Santos e Patrícia Cristina Camargo, e à Técnica de Saúde Bucal Edilaine Cristina Mendes Felipe, agradeço pelo trabalho em equipe, pelo convívio e pela atenção com todos as demandas do centro cirúrgico.

Aos pós-graduandos e residentes da área de Cirurgia Buco-Maxilo-Facial da FOP – UNICAMP, em nome de Bruno Dezen, Isabela Bergamaschi, Maria Júlia Vicentin, José Nunes, André Castanhede, Samara Galvani, Rafael Rodrigues, Gabriel Brito, Larissa França, Fernanda Calvo, Luciano Lima, Pedro Duarte, Aline Peres, André Di Spagna, Levi Saulo, Marília Pinheiro e Tiago Pecegueiro pela parceria nos atendimentos clínicos, seminários, e principalmente pela relação de amizade construída no decorrer desses anos de convívio intenso e praticamente diário.

Aos professores da banca de qualificação, Prof. Dr. Eduardo Cesar Almada Santos, Prof. Dr. Júlio Cesar Bento dos Santos e Profa. Dra. Karina Gonzales Silvério Ruiz, pela especial atenção para com este trabalho, diante das sugestões e considerações que engrandeceram o seu desenvolvimento.

Aos professores titulares da banca de defesa, Prof. Dr. Matheus Lima de Oliveira e Prof. Dr. Vitor José da Fonseca, e aos suplentes Prof. Dr. Andrés Humberto Cáceres Barreno e Profa. Dra. Elisa Bizetti Pelai, pela disponibilidade e aceite de participação.

À Profa. Dra. Elisa Bizetti Pelai, agradeço pelo auxílio no desenvolvimento deste trabalho, principalmente por compartilhar de forma extremamente didática os seus conhecimentos de metodologia científica e bioestatística, e acima de tudo, pela relação de amizade, sendo sempre muito solícita nas demandas pessoais e acadêmicas.

À minha família, em especial aos meus pais Francisco Sombra e Geane Dias, e aos meus irmãos, carinhosamente chamados de Tick, Docinho e Gê, agradeço pelo amor incondicional e incentivo em toda a minha trajetória, pelo suporte emocional e financeiro, e por não medirem esforços para a minha felicidade e realização dos meus sonhos. A distância é ínfima quando comparada à saudade e ao amor que sinto por vocês.

A todos os meus amigos da vida, em especial a Brunno Pontes, Juliana Andrade, Paola Bitarães, Mateus Dias e Jardel Santos, por sempre estarem disponíveis para ouvirem meus “causos”, pela relação de parceria, companheirismo, pelas infinitas risadas e momentos alegres compartilhados, vocês são a minha segunda família da vida.

Aos demais professores, funcionários, colegas de outras áreas e aos alunos de graduação, agradeço pelo convívio nas clínicas e ambientes comuns da FOP.

## RESUMO

A harmonia facial é determinada pelo conjunto formado entre esqueleto e tecidos moles faciais que impactam visualmente de acordo com suas estruturas e proporções. A sínfise mandibular e o mento desempenham um papel fundamental na atratividade e estética, relacionando-se diretamente à simetria facial. A sínfise mandibular também pode atuar como área doadora de enxerto ósseo autógeno em reconstruções ósseas alveolares. O presente estudo teve por objetivo avaliar e caracterizar morfometricamente a sínfise mandibular e suas estruturas, bem como identificar a ocorrência de dimorfismo sexual em 200 Tomografias Computadorizadas de Feixe Cônico (TCFC) de pacientes de ambos os sexos, entre 18 e 60 anos, armazenadas no Biobanco de Imagens Radiográficas e Tomográficas da Faculdade de Odontologia de Piracicaba – FOP/UNICAMP. Tratou-se de um estudo observacional, transversal, descritivo e retrospectivo, onde foram coletados sexo e idade dos pacientes, bem como medidas cefalométricas da espessura do mento tegumentar, através de pontos cefalométricos de Pog-Pog', Gn-Gn', Me-Me' em imagens laterais de face reconstruídas das TCFC. Ainda, foram avaliadas medidas de tecido duro da sínfise e mento ósseo relacionados à altura, espessura, projeção, área, inclinação, orientação e volume como área de interesse de enxerto autógeno (AIE) em cortes axiais, sagitais e reconstruções 3D de TCFC. Todas as mensurações foram realizadas após importação dos arquivos DICOM no *software Dolphin Imaging version 11.0.* A análise estatística e interpretação descritiva dos dados foi apresentada por meio de médias e desvio padrão, teste *t de Student* e teste de correlação de Pearson, sendo a significância estatística fixada em $p$=0,05. Os resultados demonstraram que o sexo masculino apresentou maiores valores de altura, projeção e área do mento ósseo, altura, espessura, área e orientação da sínfise ($p$<0,05). Ainda, o perfil de tecido mole foi mais espesso no sexo masculino, bem como a AIE nos valores de altura, comprimento mésio-distal e volume ($p$<0,05). Concluiu-se que houve um dimorfismo sexual, com o sexo masculino apresentando maiores dimensões de tecido duros, espessura do mento tegumentar e AIE. A avaliação da AIE demonstrou que a sínfise pode ser uma área doadora considerável na obtenção de enxerto autógeno intrabucal. Os resultados podem auxiliar no estudo da sínfise mandibular e suas estruturas, visando o planejamento de reconstruções alveolares, tratamentos ortodônticos e cirurgias ortognáticas.



Palavras-chave: Tomografia Computadorizada de Feixe Cônico. Queixo. Enxerto de osso alveolar. Cefalometria.

## ABSTRACT

Facial harmony is determined by the combination formed between the skeleton and the facial soft tissues that visually impact according to their structures and proportions. The mandibular symphysis and the chin play a fundamental role in attractiveness and aesthetics, directly relating to facial symmetry. The mandibular symphysis can also be an autogenous graft donor area for alveolar bone reconstruction. The objective of the present study was to morphometrically evaluate the mandibular symphysis and associated structures, also identifying the occurrence of sexual dimorphism in 200 Cone Beam Computed Tomography (CBCT) scans of patients of both sexes, between 18 and 60 years old, obtained from the Biobank of Radiographic and Tomographic Images of Piracicaba Dental School of the University of Campinas. This was an observational, cross-sectional, descriptive and retrospective study, in which data such as gender and age of the patients were collected, as well as measurements of the thickness of the soft tissues of the chin, through the cephalometric points of Pog-Pog', Gn-Gn', Me-Me' on lateral cephalometric images derived from CBCT. Furthermore, measurements of the hard tissue of the symphysis and bony chin related to height, thickness, projection, area, inclination, orientation and volume as an area of interest for an autogenous graft (AOI) were evaluated in axial and sagittal slices and 3D CBCT reconstructions. All measurements were performed after importing the DICOM files into the Dolphin Imaging software version 11.0. Statistical analysis and descriptive interpretation of data was presented using means and standard deviation, *t* test and Pearson correlation analysis, with statistical significance set at $p=0.05$. The results showed that males had higher values for height, projection and area of the chin, height, thickness, area and orientation of the symphysis ($p<0.05$). Additionally, the soft tissue profile was thicker in males, as well as height, mesiodistal length and AOI volume ($p<0.05$). It was concluded that there was a sexual dimorphism, with males presenting larger dimensions of hard tissue, thickness of the soft tissues of the chin and AOI. The evaluation of the AOI demonstrated that the symphysis can be a considerable donor area for obtaining intraoral autogenous graft. The results may help in the study of mandibular symphysis and its structures, aiming at planning alveolar reconstructions, orthodontic treatments and orthognathic surgeries.



Keywords: Cone-Beam Computed Tomography. Chin. Cephalometry. Alveolar Bone Grafting.

## LISTA DE ABREVIATURAS E SIGLAS

AOI – *Area of Interest*

CBCT – *Cone Beam Computed Tomography*

BLW – *Buccal-lingual width*

DICOM – *Digital Imaging and Comunications in Medicine*

CI – *Confidence Interval*

BMI – *Body Mass Index*

MDL – *Mesiodistal length*

MIP - *Maximum Intensity Projection*

PP – *Palatine Plane*

TC – Tomografias Computadorizadas

TCFC – Tomografia Computadorizada de Feixe Cônico

3D - *Three-dimensional*

**SUMÁRIO**

## 1 INTRODUÇÃO

A sínfise mandibular é uma estrutura anatômica localizada no terço anterior da mandíbula, unida entre os seis e nove meses de idade e com crescimento até o final da adolescência. É composta por osso alveolar e cortical, sendo considerada um marco primário na estética do perfil facial, representando junto aos tecidos moles um complexo estrutural interativo (EVANGELISTA et al., 2021; LINJAWI et al., 2021).

Devido à sua relação anatômica, o mento geralmente é confundido com a sínfise mandibular, todavia, está localizado anteriormente e inferiormente a esta. Sua morfologia é considerada exclusiva dos seres humanos, estando também relacionado à biomecânica mastigatória, fala, tamanho dentário anterior inferior, entre outros (OKUMURA et al., 2022).

As diferenças dimensionais do mento afetam na avaliação de contornos faciais, que são importantes características em faces harmoniosas e podem variar diante de diferentes grupos étnicos populacionais (OKUMURA et al., 2022). O perfil dos tecidos moles faciais pode corresponder ao osso adjacente, como no caso da espessura de tecido mole do mento que tem sido correlacionada às discrepâncias no plano sagital (MACARI; HANNA, 2014).

De modo geral, o sexo masculino apresenta ossos maiores e mais robustos que o feminino, e ao avaliar-se o crânio humano, a mandíbula representa uma de suas estruturas mais dimórficas, devido as suas dimensões e formato (BESCHIU et al., 2022). De acordo com alguns estudos, o sexo masculino apresentou maiores dimensões para a sínfise, mento e espessura de tecido mole frente ao sexo feminino (MACARI; HANNA, 2014; TUNIS et al., 2020)

A sínfise mandibular é comumente utilizada como área doadora de enxerto ósseo autógeno em aumentos ósseos alveolares, apresentando vantagens devido a origem mandibular ectomesenquimal e ossificação intramembranosa, o que leva à uma alta taxa de revascularização. Menores complicações e desconfortos pós-operatórios, menor custo e ausência de cicatrizes são aspectos vantajosos deste sítio intrabucal (SALEMI; FARHADIAN; EBRAHIMI, 2021).

Quando utilizada como área doadora, a sínfise deve ser avaliada quanto aos aspectos anatômicos em sua zona de segurança como determinação do comprimento, altura e profundidade da sínfise, visando a extração segura do bloco de osso autógeno, minimizando os riscos de possíveis complicações como sangramento

transoperatório, deiscência da ferida cirúrgica, danos ao nervo mentoniano, perda da vitalidade pulpar dos dentes associados, entre outras (LEE et al., 2015; SALEMI; FARHADIAN; EBRAHIMI, 2021).

Diagnósticos por imagem de tecidos duros podem ser realizados por meio de radiografias intraorais e panorâmicas, atendendo aos requisitos de imagem, todavia, apresentam limitações inerentes à ampliação e sobreposição de estruturas em sua visão bidimensional. As Tomografias Computadorizadas (TC), por sua vez, apresentam uma visão tridimensional através de múltiplas e finas fatias seccionais do corpo, permitindo um diagnóstico de condições complexas (MEUNDI; DAVID, 2019).

As Tomografias Computadorizadas de Feixe Cônico (TCFC) foram projetadas especificamente para avaliação do complexo buco-maxilo-facial, onde os raios x em formato cônico são movidos em círculos ao redor do paciente, permitindo a aquisição de imagens volumétricas de alta resolução que podem ser visualizadas nos planos ortogonais axial, sagital e coronal, bem como reconstruções tridimensionais. Em comparação às TC convencionais, apresentam uma rápida velocidade de varredura, pequenas doses de radiação e menores dimensões do equipamento (ZHENG et al., 2018; MEUNDI; DAVID, 2019).

Na avaliação de dimensões da sínfise mandibular as TCFC são eficazes, no que tange o planejamento de implantes dentários, reconstruções alveolares, na prevenção de traumas às estruturas neurovasculares, ortopedia facial, ortodontia e cirurgias ortognáticas (SCHULZE, 2011; SALEMI; FARHADIAN; EBRAHIMI, 2021; BALDINI et al., 2022).

Avaliações morfométricas são técnicas bem estabelecidas na literatura, porém dependem da determinação exata de referências anatômicas. O uso de tecnologias mediadas por computadores permitiram o aprimoramento destas técnicas, auxiliando na menor subjetividade, permitindo mensurações com maior rapidez de toda a superfície dos tecidos duros através de imagens tridimensionais (3D) (BESCHIU et al., 2022).

A descrição anatômica precisa da região de sínfise mandibular em população brasileira é escassa, e poucos estudos abordam a avaliação de seus tecidos duros e moles de forma conjunta. Diante disto, o presente estudo teve por objetivo caracterizar morfometricamente a sínfise mandibular, seus tecidos moles e duros, investigando a ocorrência de dimorfismo sexual, bem como avaliar esta como

possível área doadora de enxerto autógeno em TCFC, visando auxiliar no planejamento pré-operatório de cirurgias e procedimentos nesta região.

## 2. ARTIGO: MORPHOMETRIC EVALUATION OF THE MANDIBULAR SYMPHYSIS ASSOCIATED WITH SOFT TISSUE PROFILE AND AVAILABILITY OF AUTOGENOUS BONE GRAFT IN CONE BEAM COMPUTED TOMOGRAPHY

Artigo submetido ao periódico Clinical Oral Implants Research (Anexo 1)

Gesom Avohai Dias Sombra

Elisa Bizetti Pelai

Alexander Tadeu Sverzut

### ABSTRACT

To evaluate and morphometrically characterize the mandibular symphysis and its structures, investigate the occurrence of sexual dimorphism, as well as evaluate it as a donor area autogenous bone graft. This was an observational, cross-sectional, descriptive, and retrospective study, where 200 Cone Beam Computed Tomography (CBCT) scans of patients of both sexes, between 18 to 60 years old were included. Collected information about the sex and age of patients, as well as cephalometric measurements of the thickness of chin soft tissue, through cephalometric points of Pog-Pog', Gn-Gn', Me- Me' in reconstructed CBCT lateral face images. Moreover, measurements of the hard tissue of the symphysis and chin related to height, thickness, projection, area, inclination, orientation, and volume as an area of interest for an autogenous graft (AOI) were evaluated in axial and sagittal sections and 3D CBCT reconstructions. All measurements were performed in the Dolphin Imaging software version 11.0. Descriptive data were presented as mean and standard. The Student's t-test and Pearson's correlation test were used in the analyses. The results showed that males had higher values for height, projection, and area of the chin, height, thickness, area, and orientation of the symphysis ($p<0.05$). In addition, the chin soft tissue was thicker in males, as well as the AOI for height, length, and volume ($p<0.05$). It was concluded that there was a sexual dimorphism, where males presented larger dimensions of hard tissue, soft tissue chin and AOI. The AOI evaluation demonstrated that the symphysis can be a considerable donor area in obtaining an intraoral autogenous bone graft (2700,46 ± 808,68$mm^3$). The results can help in the study of mandibular symphysis and its structures, aiming at the planning of alveolar reconstructions, orthodontic treatments, and orthognathic surgeries.

Keywords: Cone-Beam Computed Tomography. Chin. Alveolar Bone Grafting. Cephalometry.

## INTRODUCTION

In modern dentistry, the chin and mandibular symphysis are fundamental to facial attractiveness and aesthetic perspective. The symmetry, projection, shape (height and width), and harmonious proportion of these structures concerning the upper and middle third of the face are significant characteristics in facial perception (BRAL et al., 2020; TUNIS et al., 2020; KHAN; SATTAR; ERKIN, 2021).

Facial aesthetics plays a key role in an individual's beauty and personality, which is directly influenced by the projection and shape of the chin, thus representing one of the most dominant features of the face (KHAN; SATTAR; ERKIN, 2021). Subconsciously, they are associated with the personality of individuals, where an oval or retruded shape demonstrates a sign of femininity, while their square shape expresses masculinity (MITTAL et al., 2017).

It is worth noting that facial balance and harmony are determined by the skeleton associated with soft tissues, which influence the visual impact of the face according to its structures and proportions, presenting variations in characteristics depending on the ethnic group. (GOMEZ et al., 2017; PATIL et al., 2021).

Aesthetic and functional procedures involving the anterior region of the mandible have been in evidence, such as osteotomies for the three-dimensional repositioning of the chin, osteotomies to improve respiratory conditions in phase II of the Stanford protocol, use of customized implants to correct anatomical problems that generate asymmetries, among others (VELÁSQUEZ et al., 2015; MITTAL et al., 2017).

A harmonious soft tissue profile is also the goal of treatments such as orthodontics, however, the variability of tension and thickness of the soft tissues chin can make such procedures difficult (GOMEZ et al., 2017).

Anatomical knowledge of the anterior region of the mandible is essential for performing surgeries with a low morbidity rate (VELÁSQUEZ et al., 2015). Procedures such as genioplasty require critical information about the relationship between soft and hard tissues for their correct planning (PATIL et al., 2021). Characteristics such as prominence, height, width, symmetry, positioning of the mentolabial sulcus and submental fullness are some of the relevant aspects of orthognathic surgeries (BRAL et al., 2020).

Imaging exams such as Cone Beam Computed Tomography (CBCT) and lateral teleradiography (LT) are widely used in dentistry, being requested for two-dimensional

and three-dimensional planning in the evaluation of malocclusions, maxillofacial growth, and noble structures for preoperative purposes and postoperative periods of facial orthopedics, orthodontics, and orthognathic surgeries (SCHULZE, 2011; BALDINI et al., 2022).

CBCT allows for obtaining accurate 3D images with a lower incidence of radiation when compared to conventional tomography (BALDINI et al., 2022). They are stored in DICOM (Digital Imaging and Communication in Medicine) format, which includes image data, geometric and mathematical information, and details of the acquisition and configuration of CT scans (KERNEN et al., 2020).

The accurate anatomical description of the mandibular symphysis region in the Brazilian population is scarce, yet few studies address the evaluation of its hard and soft tissues together. The aim of this study was to morphometrically characterize the mandibular symphysis, and its soft and hard tissues, investigating the occurrence of sexual dimorphism, as well as evaluating this as a possible donor area of autogenous bone graft in CBCT, purpose to assist in the preoperative planning of surgeries and procedures in this region.

## MATERIAL AND METHODS

### Study design

This observational cross-sectional, descriptive and retrospective study was performed with CBCT scans of adults between 18 and 60 years old, in Piracicaba, São Paulo, Brazil.

### Ethical aspects and Funding

This research was approved by the Research Ethics Committee of Piracicaba Dental School, Campinas State University (Number CAAE 65556222.5.0000.5418). This work was supported by the National Council for Scientific and Technological Development (CNPq), Grant Number 130518/2021-2.

### Sample and CBCT selection

The sample consisted of CBCT scans of adults, male and female, aged between 18-60 years old, and varied clinical indications. There was the exclusion of CBCT that presented the following conditions: advanced periodontal disease, pathological findings in the chin and mandible, irregular soft tissue or defective bone contour at the chin, syndromic patients, history of facial trauma, previous surgeries or presence of radiographic artifacts that affected the region studied. The FOV of CBCT included either maxilla and mandible.

### CBCT analysis

CBCT DICOM data sets were imported in the Dolphin Imaging software version 11.0 (Patterson Dental Supply, St. Paul, MN). To obtain comparable measurements, all skulls were positioned parallel to the palatine plane (PP). In the sagittal slice, a horizontal line parallel to the PP was oriented through the Pogonion (Pog). Then, in the axial slice, a line was oriented through the most protruding anterior and posterior points at the symphysis region (Figure 1), adapted from Tunis et al., 2021.

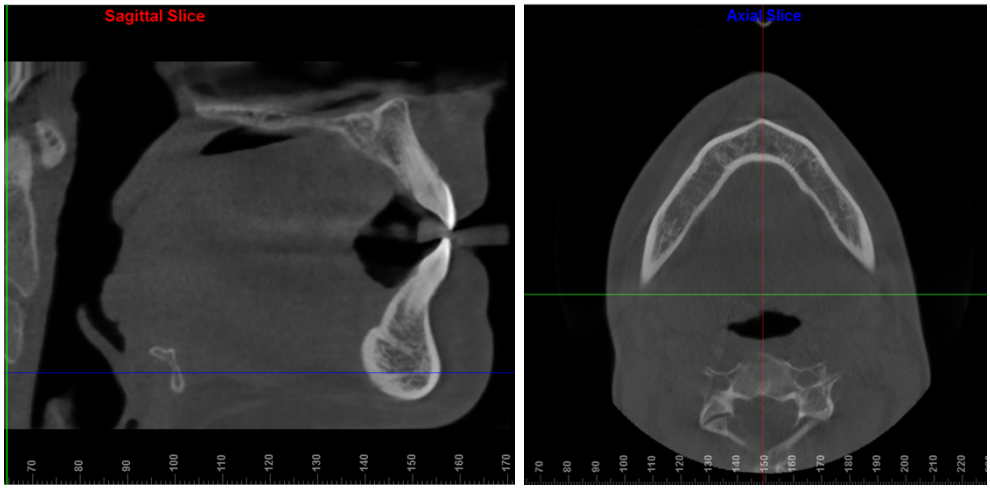



Figure 1. Patient's head orientation: First, in the sagittal view, a blue line parallel to PP through the Pog. Second, in the axial view, red line through the most anterior and posterior points of the mandibular symphysis.

Patients were categorized according to sex, followed by specific measurements for each structure. All assessments were performed by a previously calibrated researcher. The intraobserver reliability was determined, when the investigating researcher repeated all angular and linear measurements twice in about 10% of the sample that was randomly selected (n=20), in two weeks between the first and second measurements.

The dimensions of the hard tissues of the mandibular symphysis and chin were determined. Then, soft tissue thickness was evaluated, correlating them with hard tissues. The evaluation of the symphysis as an autogenous graft donor area was performed posteriorly, by defining an Area of Interest (AOI), which was evaluated and correlated with the hard tissue dimensions of the symphysis and chin. All variables were correlated with the sex and age of the patients.

**Hard tissue evaluation**

The delimitation of the hard tissue was performed in axial, sagittal slices and 3D reconstructions of the CBCT. The hard tissue was defined as the bone structure of the entire symphysis and chin, genial tubercle, and the dentoalveolar component. Linear, angular, and area measurements were carried out to evaluate symphysis and chin size, shape, and position, as proposed by Tunis et al. (2021).

*Chin evaluation*:

The following chin measurements were used (Figure 2, A to C):

Height (mm): The distance from the B point to the menton (Me)

Projection (mm): The maximum thickness of the chin, measured as the distance between the Pogonion (Pog) and the chin height line.

Area ($mm^2$): The portion of the symphysis area anterior to the chin height line

Width (mm): The linear distance between mental tubercles.

*Mandibular symphysis evaluation:*

The following symphysis measurements were used (Figure 2, D to G):

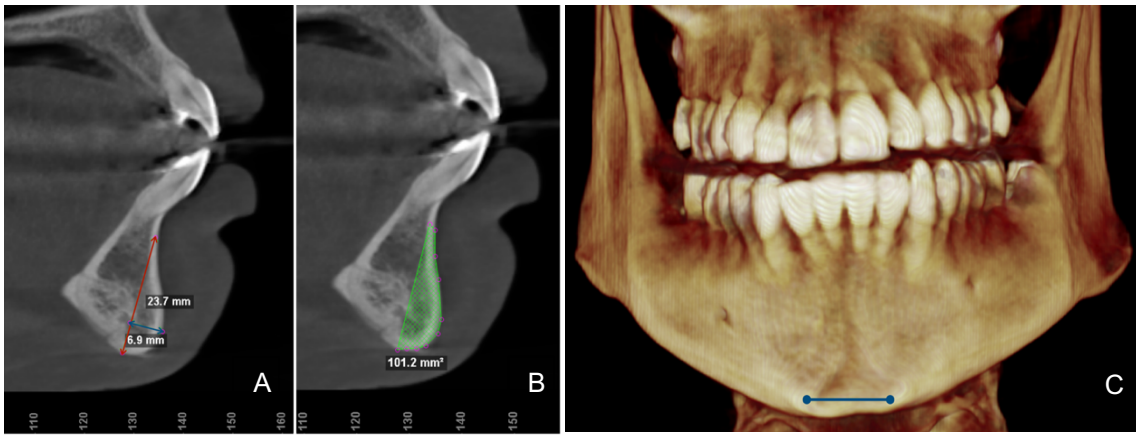
Height (mm): The distance between the most superior point of the alveolar bone to the Me

Thickness (mm): The distance from Pog to the most posterior point of the symphysis

Area ($mm^2$): The total area of the symphysis in the sagittal plane

Orientation (º): The angle (α) formed between the PP and the line passing from the Infradentale to the Gnathion (Id-Gn)

Inclination (º): The angle (β) formed by the cross-point between Id-Gn and Gn-Go (Gonion).



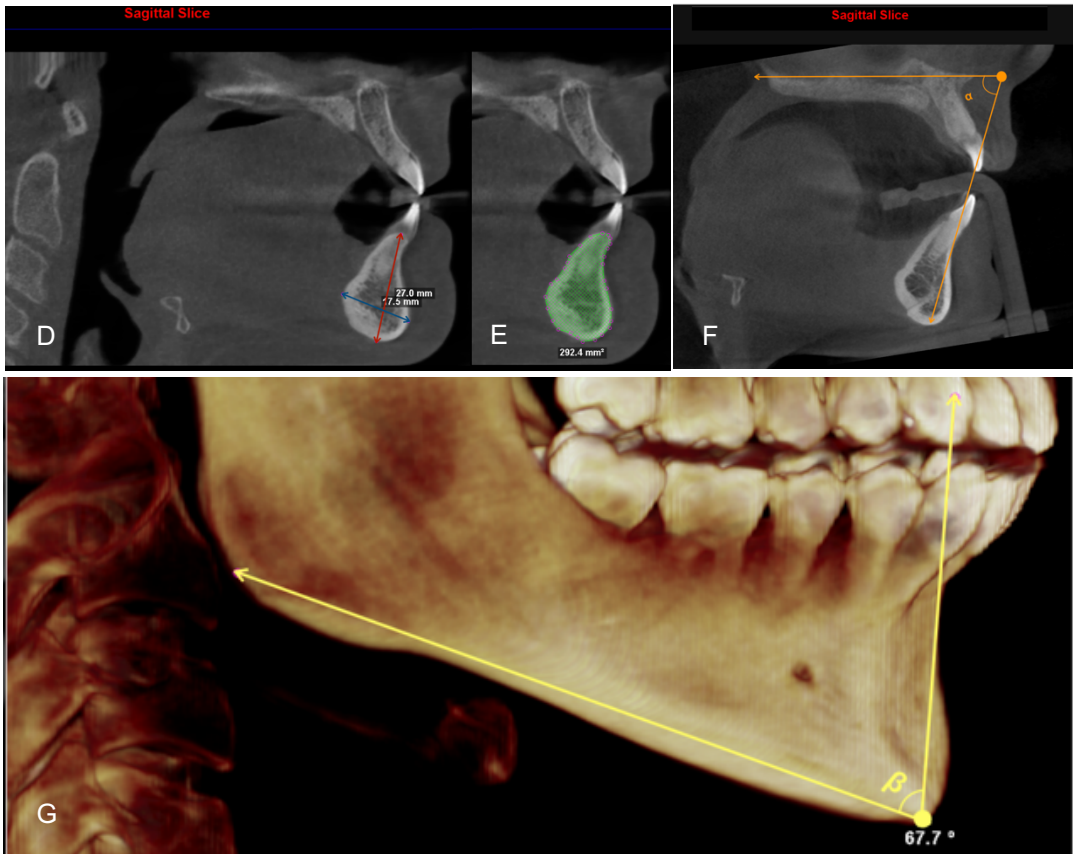



Figure 2. Chin measurements: (A) red line – height; blue line – projection; (B) green – area; and (C) width. Symphysis measurements: (D) red line – height; blue line – thickness; (E) green – area; (F) α – orientation, and (G) β – inclination.

### Soft tissue evaluation

This evaluation was performed in lateral reconstructions of CBCT in MIP (Maximum Intensity Projection). The thickness of soft tissue was measured through the distances between the cephalometric points: Pog-Pog', Gn-Gn', and Me-Me' (Figure 3).

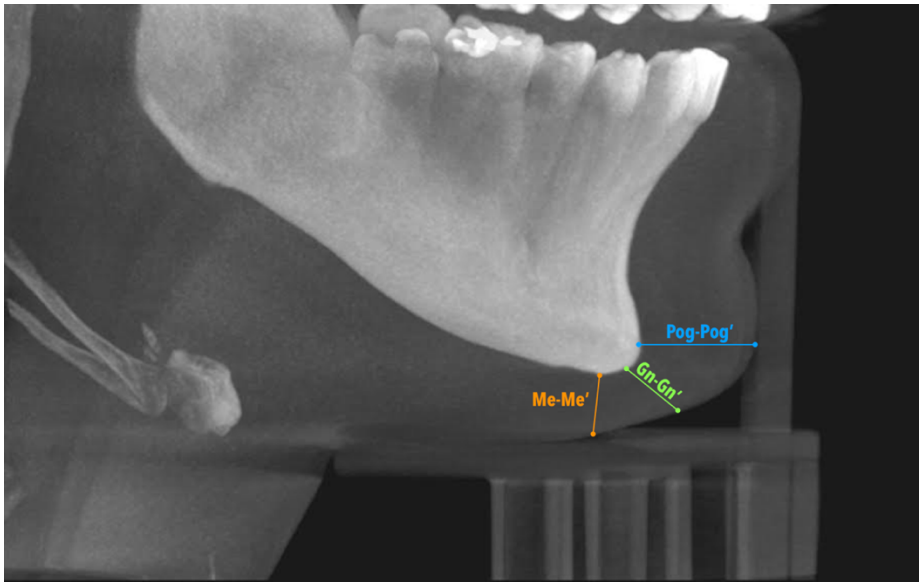



Figure 3. Soft tissue evaluation.

**Evaluation as an autogenous graft donor area**

The evaluation of the symphysis as a potential donor area for an autogenous graft was performed using the maxillary sinus volumetric evaluation tool. Firstly, the AOI (Figure 4) was defined through the below margins:

Axial slices: Distal 5mm to the mental foramens; the external margin of the mandible buccal surface, and 2mm to the mandible lingual surface.

Sagittal slices: 5mm apical to the roots of the mandibular teeth and 2mm cranial to the mandible border.

Then, volume (mm3), height (mm), mesiodistal length (MDL; mm), and buccal-lingual width (BLW; mm) were measured, adapted from Zeltner et al. (2016).


Figure 4. Determination of AOI margins

**Statistical analysis**

The sample calculation defined the minimum population at 160 CBCT (95% CI, 5% error). All data collected were computed in Microsoft Office Excel ®, version 16.66, and statistical processing was performed using the SPSS software, version 17.0 (SPSS Inc, Chicago, IL).

The data were reported using means, standard deviation (SD), 95% ranges, and medians for each variable. Student's t-test (non-paired, independent samples) was used to compare means between groups and Pearson's correlation test was used to correlate all the variables. Results of tests with *P*-values ≤ 0.05 were considered statistically significant, and correlation coefficients (R-values) >0.5 were considered strong (HULLEY et al., 2015).

## RESULTS

The study sample consisted of 200 CBCT of adult patients, 110 female patients (55%), and 90 male patients (45%), the mean patient age amounted to 31.82 ± 12.56 years. No significant differences in age and sex ($p$=0.555).

The characterization of the sample and variables studied according to the patient's sex was summarized in Table 1, and the correlation of all variables regarding sex and age was presented in Table 2.

The evaluation of the hard tissues showed statistically significant differences between sex and height, projection, and area of the chin *(*$p$=0.001). The results also showed differences between sex and height, thickness, area ($p$=0.001), and orientation ($p$=0.005) of the symphysis. Statistically significant differences were found between age and area (p=0.001) and orientation (p=0.007) of symphysis.

Soft tissue thickness and measurements showed statistically significant differences between all variables with sex (Pog-Pog': $p$=0.010; Gn-Gn': $p$=0.014) and Me-Me': $p$=0.026) and age (p=0.001).

The results of the evaluation of mandibular symphysis as a potential donor area for an autogenous bone graft showed statistically significant differences between sex and height, mesiodistal length, and volume of AOI ($p$=0.001, each). A strong correlation was found between sex and volume of AOI (r=0.502).

Table 1 – Morphometric characterization of the chin, mandibular symphysis, soft tissue and AOI according to the sex (mean, standard deviation)

| Structural assessment | Variable | Female (n=110, 55%) | Male (n=90, 45%) | Total (n=200, 100%) | CI (95%) | *p* |
|---|---|---|---|---|---|---|
| | **Age** | 31.25 ± 12.56 | 32.39 ± 12.21 | 31.82 ± 12.38 | 30.09-33.54 | 0.555 |
| **Chin** | **Height (mm)** | 20.72 ± 2.64 | 22.84 ± 2.68 | 21.68 ± 2.85 | 21.28-22.07 | 0.001* |
| | **Projection (mm)** | 4.98 ± 0.83 | 5.49 ± 0.86 | 5.21 ± 0.88 | 5.09-5.33 | 0.001* |
| | **Area (mm)** | 61.64 ± 14.09 | 72.30 ± 16.28 | 66.44 ± 15.99 | 64.20-68.67 | 0.001* |
| | **Width (mm)** | 16.60 ± 1.77 | 17.07 ± 2.07 | 16.81 ± 1.92 | 16.54-17.08 | 0.083 |
| **Symphysis** | **Height (mm)** | 30.61 ± 3.18 | 33.77 ± 2.91 | 32.03 ± 3.44 | 31.55-32.51 | 0.001* |
| | **Thickness (mm)** | 13.48 ± 1.91 | 14.43 ± 2.05 | 13.90 ± 2.03 | 13.62-14.19 | 0.001* |
| | **Area (mm)** | 265.86 ± 42.73 | 313.23 ± 52.34 | 287.19 ± 52.75 | 279.84-294.55 | 0.001* |
| | **Orientation (º)** | 75.88 ± 5.61 | 78.18 ± 5.66 | 76.91 ± 5.73 | 76.11-77.71 | 0.005* |
| | **Inclination (º)** | 75.31 ± 3.71 | 75.59 ± 3.72 | 75.44 ± 3.71 | 74.92-75.96 | 0.599 |
| **Soft Tissue** | **Pog-Pog' (mm)** | 11.77 ± 2.05 | 12.64 ± 2.66 | 12.16 ± 2.38 | 11.83-12.49 | 0.010* |
| | **Gn-Gn'(mm)** | 7.40 ± 1.63 | 8.02 ± 1.88 | 7.68 ± 1.77 | 7.43-7.92 | 0.014* |
| | **Me-Me'(mm)** | 5.41 ± 1.24 | 5.90 ± 1.82 | 5.63 ± 1.54 | 5.42-5.85 | 0.026* |
| **AOI** | **Volume ($mm^3$)** | 2333.90 ± 635.33 | 3148.47 ± 773.84 | 2700.46 ± 808.68 | 2587.69-2813.22 | 0.001* |
| | **Height (mm)** | 13.74 ± 1.77 | 15.19 ± 1.90 | 14.39 ± 1.96 | 14.12-14.67 | 0.001* |
| | **BLW (mm)** | 7.48 ± 3.07 | 8.04 ± 1.37 | 7.73 ± 2.46 | 7.39-8.08 | 0.112 |
| | **MDL (mm)** | 32.60 ± 3.12 | 34.98 ± 3.37 | 33.67 ± 3.44 | 33.19-34.15 | 0.001* |

AOI – Area of Interest; BLW – buccal-lingual width; MDL – mesiodistal length; CI – Confidence interval; * statistically significant differences ($p$<0,05); mm – millimeters; $mm^3$ – cubic millimeters; º – degree

Table 2 – Correlation of variables regarding sex and age (n=200)

| Structural assessment | Variable | Sex | | Age | |
|---|---|---|---|---|---|
| | | r | *p* | r | *p* |
| Chin | Height (mm) | 0.369 | 0.001* | -0.023 | 0.749 |
| | Projection (mm) | 0.286 | 0.001* | 0.026 | 0.717 |
| | Area (mm) | 0.333 | 0.001* | -0.014 | 0.847 |
| | Width (mm) | 0.123 | 0.083 | 0.061 | 0.393 |
| Symphysis | Height (mm) | 0.457 | 0.001* | -0.136 | 0.056 |
| | Thickness (mm) | 0.233 | 0.001* | -0.122 | 0.085 |
| | Area (mm) | 0.447 | 0.001* | -0.237 | 0.001* |
| | Orientation (º) | 0.200 | 0.005* | 0.190 | 0.007* |
| | Inclination (º) | 0.037 | 0.599 | -0.110 | 0.121 |
| Soft tissue | Pog-Pog' (mm) | 0.183 | 0.010* | 0.270 | 0.001* |
| | Gn-Gn' (mm) | 0.173 | 0.014* | 0.243 | 0.001* |
| | Me-Me' (mm) | 0.158 | 0.026* | 0.232 | 0.001* |
| AOI | Volume ($mm^3$) | **0.502** | 0.001* | -0.075 | 0.294 |
| | Height (mm) | 0.367 | 0.001* | -0.050 | 0.482 |
| | BLW (mm) | 0.113 | 0.112 | -0.013 | 0.851 |
| | MDL (mm) | 0.344 | 0.001* | -0.110 | 0.119 |

AOI – Area of Interest; BLW – buccal-lingual width; MDL – mesiodistal length; CI – Confidence interval; * statistically significant differences ($p<0.05$); strong correlation (**r>0.5**); mm – millimeters; $mm^3$ – cubic millimeters; º – degree

In the correlation between the hard tissue structures (Table 3), statistically significant differences were found between height, thickness and area of the symphysis with the height of the chin (p=0.001). A strong correlation was found between the chin with height (r=0.691), and area (r=0.555) of the symphysis. The projection of the chin presented statistically significant differences with thickness, area, orientation (p=0.001, each), and inclination of the symphysis, which showed a negative correlation (p=0.024; r=-0.60). The area of the chin showed statistically significant differences with the height, thickness, area, and orientation of the symphysis (p=0.001, each), with a strong correlation for thickness and area (r=0.586 and r=0.511, respectively). Chin width presented statistically significant differences for symphysis orientation (p=0.001).

The correlation of soft tissues with hard tissue was describe in Table 4. Statistically significant differences were found between Pog-Pog' with the height of the chin (*p*=0.014), the height and thickness of the symphysis (*p*=0.025 and *p*=0.008, respectively). Gn-Gn' (p=0.015) and Me-Me' (p=0.035) showed differences with symphysis orientation.

The measurements of AOI were correlated with the hard tissue measurements (Table 5). Volume and MDL were statistically significant with all variables of the chin and symphysis (p<0.05). The height of AOI was statistically significant with all variables too (p<0.05), except for the width of the chin (p=0.370), while for the BLW no differences were found for the height of the chin (p=0.126) and symphysis (p=0.166).

Table 3 – Correlation between symphysis and chin (n=200)

| | | Chin | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Height (mm) | | Projection (mm) | | Area (mm) | | Width (mm) | |
| | | r | *p* | r | *p* | r | *p* | r | *p* |
| Symphysis | Height (mm) | **0.691** | 0.001* | 0.116 | 0.100 | 0.342 | 0.001* | -0.117 | 0.098 |
| | Thickness (mm) | 0.320 | 0.001* | 0.432 | 0.001* | **0.586** | 0.001* | 0.087 | 0.222 |
| | Area (mm) | **0.555** | 0.001* | 0.294 | 0.001* | **0.511** | 0.001* | -0.045 | 0.529 |
| | Orientation (º) | 0.069 | 0.331 | 0.336 | 0.001* | 0.384 | 0.001* | 0.248 | 0.001* |
| | Inclination (º) | -0.041 | 0.561 | -0.160 | 0.024* | -0.115 | 0.106 | -0.136 | 0.055 |

* Statistically significant differences ($p<0.05$); strong correlation (**r>0.5**); mm – millimeters; º – degree

Table 4 – Correlation between hard tissues and soft tissues (n=200)

| Structural assessment | Variable | Soft Tissue | | | | | |
|---|---|---|---|---|---|---|---|
| | | Pog-Pog' (mm) | | Gn-Gn' (mm) | | Me-Me' (mm) | |
| | | r | *p* | r | *p* | r | *p* |
| Chin | Height (mm) | 0.173 | 0.014* | 0.040 | 0.573 | 0.053 | 0.456 |
| | Projection (mm) | -0.018 | 0.798 | 0.105 | 0.138 | 0.087 | 0.223 |
| | Area (mm) | 0.014 | 0.844 | 0.063 | 0.374 | 0.054 | 0.445 |
| | Width (mm) | 0.126 | 0.074 | 0.109 | 0.123 | 0.036 | 0.610 |
| Symphysis | Height (mm) | 0.158 | 0.025* | 0.024 | 0.733 | -0.021 | 0.769 |
| | Thickness (mm) | 0.032 | 0.652 | 0.034 | 0.634 | -0.009 | 0.894 |
| | Area (mm) | 0.187 | 0.008* | 0.067 | 0.349 | 0.007 | 0.924 |
| | Orientation (º) | -0.076 | 0.286 | 0.173 | 0.015* | 0.149 | 0.035* |
| | Inclination (º) | 0.070 | 0.323 | 0.010 | 0.892 | 0.018 | 0.798 |

* Statistically significant differences ($p<0.05$); strong correlation (**r>0.5**); mm – millimeters; º – degree

Table 5 – Correlation between hard tissues and AOI (n=200)

| Structural assessment | Variable | AOI | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Volume ($mm^3$) | | Height (mm) | | BLW (mm) | | MDL (mm) | |
| | | **r** | ***p*** | **r** | ***p*** | **r** | ***p*** | **r** | ***p*** |
| **Chin** | **Height (mm)** | 0.461 | 0.001* | 0.461 | 0.001* | 0.109 | 0.126 | 0.205 | 0.004* |
| | **Projection (mm)** | 0.450 | 0.001* | 0.226 | 0.001* | 0.305 | 0.001* | 0.357 | 0.001* |
| | **Area (mm)** | **0.583** | 0.001* | 0.471 | 0.001* | 0.255 | 0.001* | 0.381 | 0.001* |
| | **Width (mm)** | 0.171 | 0.015* | 0.064 | 0.370 | 0.168 | 0.017* | 0.172 | 0.015* |
| **Symphysis** | **Height (mm)** | 0.474 | 0.001* | **0.530** | 0.001* | 0.098 | 0.166 | 0.268 | 0.001* |
| | **Thickness (mm)** | **0.643** | 0.001* | 0.406 | 0.001* | 0.313 | 0.001* | 0.461 | 0.001* |
| | **Area (mm)** | **0.764** | 0.001* | **0.549** | 0.001* | 0.313 | 0.001* | **0.509** | 0.001* |

AOI – Area of Interest; BLW – buccal-lingual width; MDL – mesiodistal length; * Statistically significant differences ($p<0.05$); strong correlation (**r>0.5**); mm – millimeters; $mm^3$ – cubic millimeters; º – degree

## DISCUSSION

In the present study, the sample consisted of 200 CBCT of adult patients, with a prevalence of females (55%) and with no statistical difference regarding age between sex (p=0.555).

When evaluating the chin as an isolated part of the mandibular symphysis, males had larger dimensions for height (22.84 ± 2.68mm), projection (5.49 ± 0.86mm), and area (72.30 ± 16.28mm$^2$), with no difference between the width with sex (17.07 ± 2.07mm). Tunis et al. (2020) presented approximate results for height (21.58 ± 3.102 mm) and projection of the chin (4.00 ± 0.99mm), and divergent results regarding the area of the chin (53.04 ± 18.53mm) and width (28.18 ± 5.62) in the same group. According to the authors, the height and width of the chin showed a statistically significant difference in terms of sex (p=0.046 and p=0.001, respectively), which differs from our findings where, in addition to height, projection and area of the chin were also showed differences between sex (p=0.001), except for chin width (p=0.083).

The evaluation of the symphysis showed that males also had higher proportions for height (33.77 ± 2.91mm), thickness (14.43 ± 2.05mm), and area (313.23 ± 52. 34mm2), with a value of p=0.001, each. The study by Nobre et al. (2022) presented similar means regarding height (32.22 ± 4.51mm) and thickness (14.66 ± 2.08mm), but differed regarding the presence of a significant difference between the height of the symphysis and sex (p=0.063). The findings by Tunis et al. (2020) were similar to those of the present study for height (33.28 ± 3.30mm), thickness (15.46 ± 2.05mm) and area (324.72 ± 56.53mm), with an identical p value=0.001.

The orientation of the symphysis (78.18 ± 5.66º; p=0.005) also showed a statistically significant difference between sex in the present study, as well as in the study by Tunis et al. (2020) (80.24 ± 7.73º; p=0.001). The inclination of the symphysis (75.44 ± 3.71º; p=0.599) showed no statistically significant difference between sex, as well as the finding described by Nobre et al. (2022) (75.85º ± 6.19º; p=0.201).

In addition to sex, the area and orientation of the symphysis also showed differences between the patients' ages (p=0.001 and p=0.007, respectively). This alteration in the orientation of the symphysis concerning the age of the patients can infer

that aging, dental attrition or tooth wear, posterior dental loss, and altered vertical dimension of occlusion, among other factors, can lead to an anterior rotation of the mandible and, consequently, of the symphysis, thus decreasing this orientation.

In the evaluation of the hard tissues, a correlation was found between the height of the chin and the thickness, height and area of the symphysis (p=0.001, each), with a strong correlation for these last two variables (r=0.691 and r=0.555, respectively). As for the projection of the chin, thickness, area, orientation (p=0.001, each) and symphysis inclination (p=0.024) were correlated factors, with the latter presenting a negative correlation (r=0.160), inferring that one more projected chin would present a smaller inclination of the symphysis with the mandibular plane. This fact may be associated with the compensatory inclination of the symphysis as a result of maintaining the positioning of the lower incisors within the alveolar bone, which is independent of the type of occlusion and may influence the projection of the chin (NOBRE et al., 2022).

The area of the chin was statistically significant with the height, orientation, thickness, and area of the symphysis (p=0.001, each), with a strong correlation for the last two (r=0.586 and r=0.511, respectively). As for the width of the chin, there was statistical significance with the orientation of the symphysis (p=0.001), which can be influenced by mandibular rotation during facial growth, which is related to mandibular size and, consequently, dimensions of the chin (SYED; MAHMOOD; NAZIR, 2017; TUNIS et al., 2021).

In general, these correlations can be justified because the chin is an integral part of the total area of the mandibular symphysis, which leads to a direct association between factors such as height, area, and thickness of the symphysis in the chin morphometry, as seen in the results of the present study.

Measurements resulting from CBCT offer reliability due to the 1:1 ratio, where the slices and volumetric reconstructions provide greater accuracy of bone and soft tissue cephalometric points than conventional radiographs (GOMEZ et al., 2017).

In the evaluation of the soft tissue, the measurement was performed at three cephalometric points due to the non-homogeneity of shape and mechanical behavior of these structures in different areas of the chin (GOMEZ et al., 2017). The thickness of soft tissue showed significant differences between the sex for the means of all variables: Pog-

Pog' (12.64 ± 2.66mm; p=0.010), Gn-Gn' (8.02 ± 1.88mm; p=0.014), and Me-Me' (5.90 ± 1.82; p=0.026). These results corroborate the study by Gomez et al. (2017), for the means of Pog-Pog' (12.8 ± 2.6mm; p<0.001) and Gn-Gn' (8.2 ± 2.2mm; p=0.021), differing only in the mean of Me-Me' (8.6 ± 2.5mm; p<0.001).

In the study by Evangelista et al. (2021), performed with teleradiographs in lateral view of the face, the Pog-Pog' mean was similar (12.9 ± 2.6mm), however, greater divergences were identified for Gn-Gn' (10.8 ± 2. 8mm) and Me-Me' (9.3mm ± 2.5mm). However, statistically significant differences remained when comparing sex with all soft tissue variables: Pog-Pog' and Me-Me' (p=0.001, each) and Gn-Gn' (p=0.004).

In the present study, age showed a significant difference in all soft tissue variables (p=0.001, each), in contrast, the study by Evangelista et al. (2021) showed differences only in Pog-Pog' (p=0.013) and Gn-Gn' (p< 0.001). Soft tissue can present changes during life, whether in the face of mandibular resorption, loss of bone volume, joint wear of the Temporomandibular Joint, loss of elasticity and muscle firmness, skin roughness, fat accumulation, among others (WONG; MENDELSON, 2015)

In the study by Lu et al. (2020) with lateral facial teleradiography, the Pog-Pog' thickness also showed values close to those of the present study (10.44mm ± 1.69) in the preoperative period of orthodontic treatment with lower incisor retrusion, with an increase of 0.44mm ± 1.10mm in the postoperative period, where they concluded the possibility of tissue changes without changing the area after this intervention.

The correlation of hard tissue and soft tissue showed statistically significant differences between Pog-Pog' with chin height (p=0.014), height (p=0.025), and symphysis thickness (p=0.008). The orientation of the symphysis was related to the values of Gn-Gn' (p=0.015) and Me-Me' (p=0.035). These correlations can be justified due to the relationship between the dimensions of the mandibular symphysis and chin with the facial tegument, influencing the soft tissues to act in a compensatory way in their thickness in the face of the deficit or excess of the underlying hard structure (BLANCHETTE et al., 1996; NOBRE et al., 2022). Also, changes in the position of the symphysis related to its orientation with the skull can influence the adaptation of the soft tissue, as well as the facial growth and morphology of this structure (AKI et al., 1994; OKUMURA et al., 2022). We can infer that depending on its inclination concerning the fixed planes of the skull (such

as Frankfurt or palatine plane), the soft tissue of the chin may be more retracted and less projected (posterior inclination) or more projected and protruded (anterior or perpendicular inclination), directly influencing the thickness of the soft tissue, especially the lower regions such as Gn-Gn' and Me-Me'.

Differences in soft tissue values in different studies can be explained by the different analytical methods and types of radiological examinations used. The measurements in the present study were performed on lateral images obtained from CBCT, in contrast, the studies mentioned above were performed on lateral teleradiographs or 3D reconstructions of soft tissues. Furthermore, the presence of the biting apparatus and the support of the chin in the tomograph of the present study may have caused some degree of distortion, even if minimal, in the region of chin soft tissue, influencing the difference in the results of Me-Me' compared to other studies.

The results of soft tissue chin thickness can help predict changes in soft tissue positioning after orthodontic treatments or orthognathic surgeries effectively and accurately. According to Evangelista et al. (2021), genioplasty can be indicated in the correction of chin asymmetries, and even if the soft tissue response is similar to bone movement, the planning must be individualized, considering the sex, in addition to age, which must be evaluated through long-term predictive criteria, as it may influence soft tissue positioning and morphology.

The systematic review by Moragas et al. (2015) described that some proportions may be useful in planning the magnitude of the movement of the chin. In advancement and extrusion movements of the chin segment, proportions of 0.9:1 were found for Pog':Pog in the horizontal and 0.95:1 for Me':Me in the vertical. Setback and impaction movements showed proportions of 0.52:1 for Pog':Pog horizontally and 0.43:1 for Me':Me vertically. The authors corroborate that the type of osteotomy, the magnitude of movement, quantity and quality of the soft tissue, among other variables, should be evaluated in this planning.

In general, the present study showed that the chin soft tissue is part of a structural complex together with the hard tissues, being influenced by patterns of chin height, height, area, and orientation of the symphysis, as well as by the sex and age of the individuals.

In the evaluation of mandibular symphysis as a potential donor area for an autogenous graft, there was a statistically significant difference in AOI values, where males had larger dimensions for volume (3148.47 ± 773.84mm3), height (15.19 ± 1.90mm), and MDL (34.98 ± 3.37mm) (p=0.001, each). The values were close to those found by Ataman-Duruel et al. (2020) for the volume (3140 ± 1050mm3), and different for height (13.36 ± 3.71mm) and MDL (29.76 ± 7.17mm). Furthermore, the authors found no significant difference between sex (p>0.05), which differed from the present study.

The mean volume of the AOI in the present study also corroborates the values described by Brockmeyer et al. (2022) (3100 ± 1110mm3) and by Zeltner et al. (2016) (3500 ± 1300mm3). In contrast, Husseini et al. (2021) found values of 1300 ± 540mm3 and Guimarães et al. (2020) of 628.61mm3. The differences in these absolute values when compared with the previously mentioned studies can be explained by the divergent analytical methods, software, in the delimitation of the AOI, osteotomy design, reference points and anatomical limits in the definition of safety margins.

Regarding the correlation between the chin and symphysis values according to the AOI, the volume and MDL were significant for all chin and symphysis variables (p<0.05). The height of the AOI also showed statistical difference for all chin and symphysis variables (p<0.05), except for the chin width (p=0.370), while for the BLW no differences were found only for chin height (p=0.126) and symphysis height (p=0.166). The volume of the AOI showed a strong correlation with the area of the chin, thickness and area of the symphysis (r>0.5). The height of the AOI showed a strong correlation with the height and area of the symphysis, while the MDL correlated strongly only with the symphysis area.

Therefore, it can be inferred that the dimensions of the mandibular symphysis are directly related to the availability of the autogenous bone graft in all AOI variables. The preoperative evaluation is fundamental in the evaluation of the AOI, to obtain an adequate bone volume according to the patient's bone defect and bone augmentation or reconstruction technique.

In general, the population of this study showed the occurrence of a sexual dimorphism, where the male sex presented the highest mean values (p<0.05) for the dimensions of the mandibular symphysis, chin, soft tissue thickness and AOI measurements.

**Limitations and strengths of the study**

Limitations of the present study are due to the absence of individual information from patients for correlations of findings with ethnic aspects and BMI (Body Mass Index), which may influence the measurements obtained from the hard tissues, facial soft tissues and chin soft tissue thickness (GOMEZ et al., 2017). The reduced FOV of the CBCT scans made it impossible to determine the sagittal facial pattern. Other limitations could be related to the absence of a history of orthodontic treatment, the resolution of CBCT, the positioning of the patient when performing the tomographic examination, the choice of the reference plane that can vary according to the studies, artifacts in the CBCT images resulting from movements during the exam, varied measurements according to the image acquisition technique and the software used to perform the analysis, among others.

The strengths of this study included its complete data collection, which allowed the evaluation of the mandibular symphysis as an interdependent complex composed of hard and soft tissues, which allowed the understanding of the relationship between these structures. In addition, the evaluation of the bone availability of the symphysis as a donor autogenous bone graft was performed through the delimitation of AOI. According to the review carried out before the study, no studies were found that carried out such a correlation in the same study and sample.

**Contributions to clinical practice**

Clinically, the results of the present study can help in the planning of orthodontic treatments, orthognathic surgeries, genioplasty and rehabilitation with dental implants, which should take into account factors such as the positioning of lower incisors, the three-dimensional dimensions of the bone, the inclination of the mandible, the thickness of the soft tissue, the relationship between noble structures, among others, aiming at a result that meets the expectations of patients and minimizes postoperative complications. The treatment must consider the symphysis and its associated structures as an interdependent complex, emphasizing the symmetry and proportionality of the face for a correct facial balance.

**Suggestions for future studies**

In order to generalize the results, new multicentric studies must be carried out, in different populations and geographic regions, which evaluate the mandibular symphysis, the chin and its correlation with the facial soft tissues, as well as the evaluation of the symphysis as a donor area of autogenous bone graft through an AOI, through standardized protocols that validate the measurements obtained in CBCT and other imaging techniques, such as lateral teleradiography and traditional cephalometric analysis.

## CONCLUSION

The results provided evidence of sexual dimorphism, where males had larger dimensions of the symphysis, chin, thickness chin soft tissue, and greater proportions in volume, height, BLW and MDL length of the AOI.

The mandibular symphysis proved to be a considerable option as a donor area for an intraoral autogenous bone graft, respecting the AOI parameters and noble anatomical structures. Therefore, the results of the study can help in the planning of alveolar reconstructions, orthodontic treatments, orthognathic surgeries and genioplasty, among others.

## REFERENCES


AKI, T. et al. Assessment of symphysis morphology as a predictor of the direction of mandibular growth. **American Journal of Orthodontics and Dentofacial Orthopedics**, v. 106, n. 1, p. 60-69, 1994.

ATAMAN-DURUEL, E. T. et al. Quantity and Quality of Intraoral Autogenous Block Graft Donor Sites with Cone Beam Computed Tomography. **International Journal of Oral & Maxillofacial Implants**, v. 35, n. 4, 2020.

BLANCHETTE, M.E. et al. A longitudinal cephalometric study of the soft tissue profile of short-and long face syndromes from 7 to 17 years. **American journal of orthodontics and dentofacial orthopedics**, v. 109, n. 2, p. 116-131, 1996.

BRAL, A. et al. A prospective study of soft-and hard-tissue changes after mandibular advancement surgery: midline changes in the chin area. **American Journal of Orthodontics and Dentofacial Orthopedics**, v. 157, n. 5, p. 662-667, 2020.

BROCKMEYER, P. et al. Informational content of two-dimensional panoramic radiographs and lateral cephalometric radiographs with respect to the bone volume of intraoral donor regions considering CBCT imaging. **BMC Oral Health**, v. 22, n. 1, p. 1-11, 2022.

EVANGELISTA, K. et al. Factors associated with the morphology of the mandibular symphysis and soft tissue chin. **Dental Press Journal of Orthodontics**, v. 26, 2021.

GOMEZ, Y. et al. Cross-sectional human study of soft tissue chin (STC) thickness in adult patients in relation to sex, facial pattern and skeletal class. **Journal of Cranio-Maxillofacial Surgery**, v. 45, n. 8, p. 1205-1211, 2017.

GUIMARÃES, G.M.M.F. et al. Evaluation of bone availability for grafts in different donor sites, through computed tomography. **Journal of Applied Oral Science**, v. 28, 2020.

HULLEY, S. B. et al. Delineando a pesquisa clínica - 4.ed. **Artmed Editora**, 2015.

HUSSEINI, B. et al. Three-dimensional radiographic assessment of the mandibular interforaminal donor site in different vertical facial growth types. **Journal of Stomatology, Oral and Maxillofacial Surgery**, v. 123, n. 1, p. 9-15, 2021.

KERNEN, F. et al. A review of virtual planning software for guided implant surgery-data import and visualization, drill guide design and manufacturing. **BMC Oral Health**, v. 20, n. 1, p. 1-10, 2020.

KHAN, M.; SATTAR, N.; ERKIN, M. Postoperative Complications in Genioplasty and Their Association with Age, Gender, and Type of Genioplasty. **International Journal of Dentistry**, v. 2021, 2021.

LU, W. et al. Orthodontic incisor retraction caused changes in the soft tissue chin area: a retrospective study. **BMC Oral Health**, v. 20, p. 1-7, 2020.

MITTAL, G. et al. The Art of Genioplasty: An insight. **Int J Oral Health Med Res**, v. 4, n. 3, p. 86-94, 2017.

MORAGAS, J.S.M. et al. A systematic review on soft-to-hard tissue ratios in orthognathic surgery part II: Chin procedures. **Journal of Cranio-Maxillofacial Surgery**, v. 43, n. 8, p. 1530-1540, 2015.

NOBRE, R. et al. The relation between mandibular symphysis and the Angle class in orthodontic treatment. **Medicine and Pharmacy Reports**, v. 95, n. 4, p. 446-454, 2022.

OKUMURA, Y. et al. Chin Morphology in Relation to the Skeletal Pattern, Age, Gender, and Ethnicity. **Applied Sciences**, v. 12, n. 24, p. 12717, 2022.

PATIL, H. S. et al. Comparative evaluation of soft tissue chin thickness in adult patients with skeletal class II malocclusion with various vertical growth patterns: a cephalometric study. **Folia Medica**, v. 63, n. 1, p. 74-80, 2021.

SYED, S.T.; MAHMOOD, Amjad; NAZIR, Rozina. Comparison of symphysis morphology in normodivergent patients of short and normal mandible. **Pakistan Orthodontic Journal**, v. 9, n. 2, p. 87-92, 2017.

TUNIS, T.S. et al. Are chin and symphysis morphology facial type–dependent? A computed tomography-based study. **American Journal of Orthodontics and Dentofacial Orthopedics**, v. 160, n. 1, p. 84-93, 2021.

TUNIS, T.S. et al. Variation in chin and mandibular symphysis size and shape in males and females: A CT-based study. **International journal of environmental research and public health**, v. 17, n. 12, p. 4249, 2020.

VELÁSQUEZ, H. et al. Morfología ósea de sínfisis mandibular: estudio piloto. **International Journal of Morphology**, v. 33, n. 1, p. 355-360, 2015.

WONG, C.; MENDELSON, B. Newer understanding of specific anatomic targets in the aging face as applied to injectables: aging changes in the craniofacial skeleton and facial ligaments. **Plastic and Reconstructive Surgery**, v. 136, n. 5S, p. 44-48, 2015.

ZELTNER, M. et al. Volumetric analysis of chin and mandibular retromolar region as donor sites for cortico-cancellous bone blocks. **Clinical oral implants research**, v. 27, n. 8, p. 999-1004, 2016.

## 3 CONCLUSÃO

Os resultados demonstraram uma relação íntima entre as dimensões da sínfise e do mento, onde os valores de altura e área do mento apresentaram correlação forte com a altura, área e espessura da sínfise.

Foi identificada a presença de um dimorfismo sexual, onde o sexo masculino apresentou maiores dimensões de sínfise e mento ósseo, um perfil de tecido mole do mento tegumentar mais espesso e maiores proporções da AOI quanto ao volume, altura, BLW e MDL.

O tecido mole relacionou-se com o mento e a sínfise mandibular nos valores de Pog-Pog' com a altura do mento, altura e área da sínfise, enquanto que Gn-Gn' e Me-Me' foram associados com a orientação da sínfise.

A sínfise mandibular demonstrou ser uma opção considerável como área doadora de enxerto autógeno intrabucal, respeitando-se os parâmetros da AOI frente às estruturas anatômicas nobres. Ainda, os valores específicos da AOI estiveram relacionados às dimensões da sínfise e do mento ósseo em praticamente todas as variáveis, com exceção da sua largura com a largura do mento e da BLW com as alturas do mento e sínfise.

Sendo assim, espera-se que os resultados do estudo possam auxiliar no planejamento de reconstruções alveolares, tratamentos ortodônticos, cirurgias ortognáticas, entre outros, respeitando-se a harmonia facial do paciente ao considerar o complexo entre os perfis de tecidos duros e moles da região da sínfise mandibular.

**REFERÊNCIAS***

BALDINI, B. et al. Cephalometric measurements performed on CBCT and reconstructed lateral cephalograms: a cross-sectional study providing a quantitative approach of differences and bias. **BMC Oral Health**, v. 22, n. 1, p. 1-12, 2022.

BESCHIU, L.M. et al. Cranial and Odontological Methods for Sex Estimation — A Scoping Review. **Medicina**, v. 58, n. 9, p. 1273, 2022.

EVANGELISTA, K. et al. Factors associated with the morphology of the mandibular symphysis and soft tissue chin. **Dental Press Journal of Orthodontics**, v. 26, 2021.

LEE, J. et al. Topographic analysis of the mandibular symphysis in a normal occlusion population using cone-beam computed tomography. **Experimental and Therapeutic Medicine**, v. 10, n. 6, p. 2150-2156, 2015.

LINJAWI, A.I.L. et al. Mandibular symphysis dimensions in different sagittal and vertical skeletal relationships. **Saudi Journal of Biological Sciences**, v. 28, n. 1, p. 280-285, 2021.

MACARI, A.T.; HANNA, A.E. Comparisons of soft tissue chin thickness in adult patients with various mandibular divergence patterns. **Angle Orthodontist**, v. 84, n. 4, p. 708-714, 2014.

MEUNDI, M.A.; DAVID, C.M. Application of cone beam computed tomography in facial soft tissue thickness measurements for craniofacial reconstruction. **Journal of oral and maxillofacial pathology: JOMFP**, v. 23, n. 1, p. 114, 2019.

OKUMURA, Y. et al. Chin Morphology in Relation to the Skeletal Pattern, Age, Gender, and Ethnicity. **Applied Sciences**, v. 12, n. 24, p. 12717, 2022.

SALEMI, F.; FARHADIAN, M.; EBRAHIMI, M. Anatomical variations of the mandibular symphysis in a normal occlusion population using cone-beam computed tomography. **Maedica**, v. 16, n. 2, p. 230, 2021.

SCHULZE, R. K. Computed tomography, cone beam computed tomography and magnetic resonance imaging diagnostic possibilities in dentistry. **International Journal of Stomatology & Occlusion Medicine**, v. 4, n. 1, p. 2-9, 2011.

TUNIS, T.S. et al. Variation in chin and mandibular symphysis size and shape in males and females: A CT-based study. **International journal of environmental research and public health**, v. 17, n. 12, p. 4249, 2020.

ZHENG, J. et al. Sex determination of Han adults in Northeast China using cone beam computer tomography. **Forensic science international**, v. 289, p. 450-457, 2018.

*De acordo com as normas da UNICAMP/FOP, baseadas na padronização do International Committee of Medical Journal Editors - Vancouver Group. Abreviatura dos periódicos em conformidade com o PubMed.

# ANEXOS

## Anexo 1 – Certificado de Comitê de Ética e Pesquisa (CEP)

UNICAMP - FACULDADE DE ODONTOLOGIA DE PIRACICABA DA UNIVERSIDADE DE CAMPINAS - FOP/UNICAMP

**PARECER CONSUBSTANCIADO DO CEP**

**DADOS DO PROJETO DE PESQUISA**

**Título da Pesquisa:** AVALIAÇÃO MORFOMÉTRICA DA SÍNFISE MANDIBULAR EM EXAMES DE
**Pesquisador:** GESOM AVOHAI DIAS SOMBRA
**Área Temática:**
**Versão:** 2
**CAAE:** 65556222.5.0000.5418
**Instituição Proponente:** Faculdade de Odontologia de Piracicaba - Unicamp
**Patrocinador Principal:** Financiamento Próprio

**DADOS DO PARECER**

**Número do Parecer:** 5.823.170

**Situação do Parecer:**
Aprovado

**Necessita Apreciação da CONEP:**
Não

PIRACICABA, 16 de Dezembro de 2022

**Assinado por:**
**jacks jorge junior**
**(Coordenador(a))**

**Endereço:** Av.Limeira 901 Caixa Postal 52, Prédio Administrativo, Segundo Piso, Setor de Secretarias de Ensino
**Bairro:** Areião **CEP:** 13.414-903
**UF:** SP **Município:** PIRACICABA
**Telefone:** (19)2106-5349 **Fax:** (19)2106-5349 **E-mail:** cep@fop.unicamp.br

## Anexo 2 – Comprovante de Submissão do Artigo

Gmail **Gesom Dias <gesomsaid@gmail.com>**

**Submission for Clinical Oral Implants Research**
1 mensagem

**Clinical Oral Implants Research** <no-reply@atyponrex.com> 29 de maio de 2023 às 09:43
Para: Gesom Sombra <gesomsaid@gmail.com>

Dear Gesom Sombra,

Thanks for complete your submission to *Clinical Oral Implants Research*. You can access your submission using this link:

New submission from 29 May 2023 12:39

Your submission entitled "MORPHOMETRIC EVALUATION OF THE MANDIBULAR SYMPHYSIS ASSOCIATED WITH SOFT TISSUE PROFILE AND AVAILABILITY OF AUTOGENOUS BONE GRAFT IN CONE BEAM COMPUTED TOMOGRAPHY" has been received by *Clinical Oral Implants Research*.

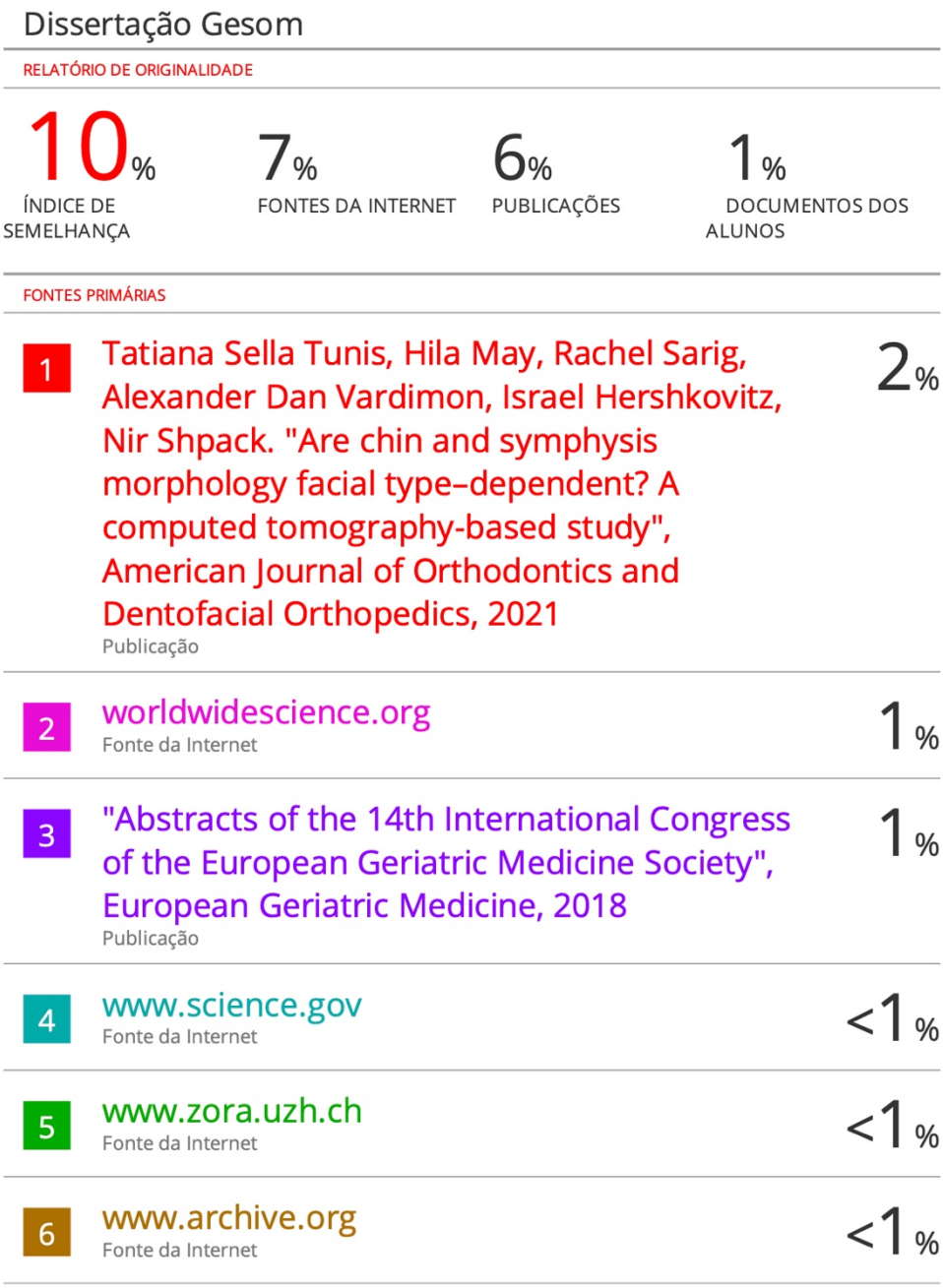
Need more help?

- For technical issues with our online submission system, contact submissionhelp@wiley.com
- For editorial questions or issues, contact the journal's editorial office

Sincerely,
The Editorial Staff at Clinical Oral Implants Research

By submitting a manuscript to or reviewing for this publication, your name, email address, and affiliation, and other contact details the publication might require, will be used for the regular operations of the publication, including, when necessary, sharing with the publisher (Wiley) and partners for production and publication. The publication and the publisher recognize the importance of protecting the personal information collected from users in the operation of these services and have practices in place to ensure that steps are taken to maintain the security, integrity, and privacy of the personal data collected and processed. You can learn more by reading our data protection policy. In case you don't want to be contacted by this publication again, please send an email to CLRoffice@wiley.com.

**Anexo 3 - Verificação de Originalidade e Prevenção de Plágio**



Dissertação Gesom

RELATÓRIO DE ORIGINALIDADE

| 10% | 7% | 6% | 1% |
|---|---|---|---|
| ÍNDICE DE SEMELHANÇA | FONTES DA INTERNET | PUBLICAÇÕES | DOCUMENTOS DOS ALUNOS |

FONTES PRIMÁRIAS

| | | |
|---|---|---|
| 1 | Tatiana Sella Tunis, Hila May, Rachel Sarig, Alexander Dan Vardimon, Israel Hershkovitz, Nir Shpack. "Are chin and symphysis morphology facial type–dependent? A computed tomography-based study", American Journal of Orthodontics and Dentofacial Orthopedics, 2021<br>Publicação | 2% |
| 2 | worldwidescience.org<br>Fonte da Internet | 1% |
| 3 | "Abstracts of the 14th International Congress of the European Geriatric Medicine Society", European Geriatric Medicine, 2018<br>Publicação | 1% |
| 4 | www.science.gov<br>Fonte da Internet | <1% |
| 5 | www.zora.uzh.ch<br>Fonte da Internet | <1% |
| 6 | www.archive.org<br>Fonte da Internet | <1% |