UNIVERSIDADE ESTADUAL DE CAMPINAS
FACULDADE DE ODONTOLOGIA DE PIRACICABA

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ESTUDO DO CANALIS SINUOSUS DA MAXILA EM TOMOGRAFIA COMPUTADORIZADA DE FEIXE CÔNICO E COMPLICAÇÕES CIRÚRGICAS: REVISÃO SISTEMÁTICA E META-ANÁLISE

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STUDY OF CANALIS SINUOSUS OF THE MAXILLA IN CONE BEAM COMPUTERIZED TOMOGRAPHY AND ITS SURGICAL COMPLICATIONS: SYSTEMATIC REVIEW AND META-ANALYSIS

Dissertação apresentada à Faculdade de Odontologia de Piracicaba da Universidade Estadual de Campinas como parte dos requisitos exigidos para a obtenção do título de Mestra 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 Clinical Dentistry, in Oral and Maxillofacial Surgery area.

Orientadora: Profa. Dra. Luciana Asprino

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A Comissão Julgadora dos trabalhos de Defesa de Dissertação de Mestrado, em sessão pública realizada em 22 de Fevereiro de 2024, considerou a candidata Samara Caroline Fernandes Galvani aprovada.

Profa. Dra. Luciana Asprino

Prof. Dra. Elisa Bizetti Pelai

Prof. Dra. Martha Alayde Alcantara Salim Venancio

A Ata da Defesa com as respectivas assinaturas dos membros encontra-se no processo de vida acadêmica do aluno

DEDICATÓRIA

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RESUMO

O canal sinuoso da maxila (CS) é um canal ósseo tortuoso que se origina no canal infraorbitário, contém um feixe vasculonervoso constituído pelo nervo alveolar superior anterior, suas artérias e veias correspondentes, podendo ter complicações clínicas. Desta forma, o objetivo deste estudo foi investigar a prevalência, variações anatômicas, localização topográfica do CS e complicações cirúrgicas relatadas. Para isso, realizou-se revisão sistemática baseada nas diretrizes *Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA),* registrada na base de dados Prospero (CRD42023458791). Foram aplicadas buscas estratégicas nas bases de dados *PubMed, EMBASE, Scopus, Web of Science e LILACS*, até o ano de 2023. Foram incluídos estudos observacionais retrospectivos e relatos de casos clínicos de pacientes de 9 a 93 anos de idade, submetidos a exame de tomografia computadorizada de feixe cônico (TCFC), não houveram restrições quanto ao ano e linguagem. Dois revisores realizaram a extração dos dados e avaliaram o risco de viés dos estudos incluídos por meio do checklist proposto por AQUA (*Anatomical Quality Assessment Tool of meta-analyses and systematic reviews).* Foram excluídos artigos de revisão, capítulos de livros, resumos de conferências, cartas para o editor, estudos que não utilizaram TCFC e opiniões de especialistas. Foi realizada meta analise de prevalência por meio do *software MetaXL 5.3 (EpiGear International, Queensland, Australia)*. Foram encontrados 334 estudos, dos quais 52 foram selecionados para títulos e resumos e 32 para leitura do texto completo, sendo 23 manuscritos incluídos na análise final. Estudos excluídos com motivos estão disponíveis mediante solicitação. A prevalência de CS variou de 36,2% a 100%. O diâmetro foi relatado na maioria dos estudos como maior que 1 mm, bilateralmente, porção terminal na região palatina, associado ao incisivo central. Não houveram diferenças relatadas em relação à idade ou ao sexo. As complicações cirúrgicas podem ser intraoperatórias: hemorragias e pós-operatórias: alterações neurossensoriais, dor e falha na osseointegração de implantes dentários. As variações anatômicas da maxila não muito comumente são retratadas na literatura e, em vários casos, sua presença é desconhecida ou não diagnosticada pelo cirurgião dentista, levando a iatrogenias como: complicações trans e pós operatórias, além de procedimentos desnecessários.

Palavras-chave: Anatomia. Nervo Maxilar. Tomografia Computadorizada Cone-Beam. Morfologia. Prevalência. Implantes Dentários. Parestesia.

ABSTRACT

The sinuous canal of the maxilla (SC) is a tortuous bone canal that originates in the infraorbital canal. It contains a vascular-nervous bundle consisting of the anterior superior alveolar nerve and its corresponding arteries and veins, and may have clinical complications. Therefore, the objective of this study was to investigate the prevalence, anatomical variations, topographic location, and related surgical complications. To this end, a systematic review was carried out based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, registered in the Prospero database (CRD42023458791). Strategic researches were carried out in the PubMed, EMBASE, Scopus, Web of Science and LILACS databases up to 2023. Retrospective observational studies and clinical case reports of adult patients from 9 to 93 years of age, undergoing computed tomography examinations were included. For cone beam computed tomography (CBCT), there were no restrictions regarding the year or language. Two reviewers performed data protection and assessed the risk of bias in the included studies using the checklist proposed by AQUA (Anatomical Quality Assessment Tool for Meta-Analyses and Systematic Reviews). Review articles, book chapters, conference abstracts, letters to the editor, studies that did not use CBCT, and expert opinions were excluded. Prevalence meta-analysis was performed using MetaXL 5.3 software (EpiGear International, Queensland, Australia). 334 studies were identified, of which 52 were selected for titles and abstracts and 32 for full text reading, with 23 manuscripts included in the final analysis. Excluded studies are available upon request. The prevalence of SC ranges from 36.2% to 100%. In most studies, the diameter was reported to be greater than 1 mm by bilaterally, in the terminal portion of the palatal region, associated with the central incisor. There were no differences related to age or sex. Surgical complications can be intraoperative (hemorrhages) or postoperative: neurosensory changes, pain and failure in the osseointegration of implants. Anatomical variations of the maxilla are not very commonly portrayed in the literature, and, in several cases, their presence is unknown or unnoticed by the dental surgeon. This leads to iatrogenesis such as perioperative complications, in addition to unnecessary procedures.

Keywords: Anatomy. Maxillary Nerve. Cone-Beam Computed Tomography. Morphology. Prevalence. Dental Implants. Paresthesia.

LISTA DE ABREVIATURAS E SIGLAS

AD	Ápice Dentário
CS	Canal Sinuoso
SC	Sinuous Canal
FIG	Figura
TCFC	Tomografia computadorizada de feixe cônico
MM	Milimetros
NR	Not Reported
USA	United States of America
CBCT	Cone beam computed tomography
CN V	Quinto Par de Nervos Cranianos

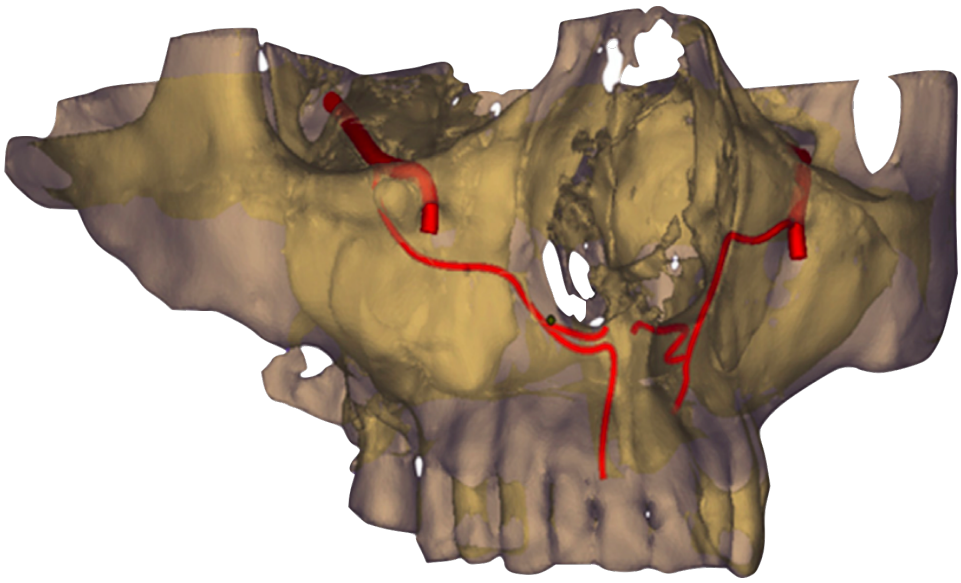
SUMÁRIO

1 INTRODUÇÃO

O canal sinuoso (CS) é uma estrutura intraóssea encontrada na porção anterior da maxila. Passa por ele o nervo alveolar superior anterior e vasos, emerge aproximadamente 25 mm atrás do forame infraorbital e vai até a abertura nasal anterior (BAENA-CALDAS et al., 2019).

Este canal anatômico foi descrito pela primeira vez em 1939 (JONES) como uma estrutura anatômica neurovascular, que sai do nervo infraorbital através da parte posterior do forame infraorbital e percorre lateralmente através de um canal ósseo (figura 1) de cerca de 2mm de diâmetro ao lado da cavidade nasal.

Figura 1. Trajeto do canal sinuoso emergindo dos canais infraorbitais bilateralmente.



Fonte: MACHADO et al., 2016.

O nervo infraorbital é um ramo do nervo trigêmeo e continuação do nervo maxilar, ele se diferencia em “infraorbital” após ter entrado na órbita ocular pela fissura orbital inferior. Inerva o terço médio da face se dividindo em três ramos proximais, nervos alveolares superiores posterior, médio e anterior, e três ramos distais, palpebral inferior, nasal lateral e labial superior (OLENCZAK et al., 2015). Não muito comumente, os CS da maxila são retratados na literatura e, em vários casos, sua presença é desconhecida ou despercebida pelo cirurgião dentista (GUIMARÃES et al., 2019).

Na revisão de literatura de Oliveira-Neto et al. (2023), foram avaliados um total de 1994 indivíduos, sendo encontrada a presença de 80% do CS em sua amostra (DE OLIVEIRA-NETO et al., 2023). De acordo com Aoki et al. (2020), os adultos apresentam o CS com média de 2 mm de diâmetro (AOKI, et al., 2020), ainda, Ferlin et al. (2019), referiu em sua revisão sistemática que o CS apresentou variações em seu curso, localização e diâmetro.

A visualização do CS é prejudicada em exames imaginológicos bidimensionais, devido à sobreposição de estruturas na formação da imagem, o que dificulta o diagnóstico. O CS mostra-se como estrutura radiolúcida ou hipodensa. Quando mais calibroso pode ser visualizado em radiografias, como uma área de menor densidade (radiolucida) na região de incisivos e caninos superiores; entretanto, devido ao seu aspecto imaginológico ser pouco descrito na literatura, este pode ser confundido com condições patológicas como lesões periapicais ou reabsorções radiculares (MANHÃES JÚNIOR et al., 2016). O exame de tomografia computadorizada de feixe cônico (TCFC) é considerado o padrão ouro para o diagnóstico no CS (ALKIS; ATA; TAS, 2023).

O CS tem sido pouco explorado e muitos profissionais não possuem conhecimento de sua existência e localização (FERNANDES et al., 2022). O conhecimento anatômico das estruturas neurovasculares presentes nesta região é de fundamental importância e pode permitir que o cirurgião evite complicações durante e após os procedimentos cirúrgicos de exodontias, implantes dentários e também de em tratamentos endodônticos na região (BRIDI et al., 2021). Quando presente, o CS está associado à região estética da maxila, onde o cirurgião está corriqueiramente preocupado com outros fatores para planejamento de implantes dentários, como por exemplo, disponibilidade e qualidade ósseas e fenótipo gengival (FIGUEIREDO et al., 2011). Entretanto, a falta de conhecimento sobre o CS pode resultar na perda do implante e alterações neurossensoriais, se for instalado comprimindo essas estruturas (DE OLIVEIRA-SANTOS et al., 2013). O desconhecimento dessa estrutura pode levar a consequências trans e pós-operatórias como alterações neurossensoriais.

Quanto aos pacientes, espera-se que eles se beneficiem da aplicação prática do conhecimento do CS por parte dos profissionais, que poderão realizar o correto planejamento e execução dos procedimentos odontológicos, atuando de forma preventiva a possíveis complicações. Assim, este trabalho justifica-se na necessidade de reunir, atualizar e divugar os conhecimentos acerca da prevalência e variações anatômicas do CS.

2 ARTIGO

This paper was submitted to International Journal of Oral & Maxillofacial Surgery.

STUDY OF CANALIS SINUOSUS OF THE MAXILLA IN CONE BEAM COMPUTERIZED TOMOGRAPHY AND ITS SURGICAL COMPLICATIONS: SYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT

The sinuous canal of the maxilla is an intraosseous canal through which the anterosuperior alveolar neurovascular bundle passes. Many professionals are unaware of its existence, which can lead to iatrogenic injuries. The objective of this systematic review was to determine the prevalence of the sinuous canal, imaging aspects related to its detection, prevalence, and topographic location identified on cone beam computed tomography, and its surgical complications. Strategic searches were carried out in the PubMed, EMBASE, Scopus, Web of Science and LILACS databases, until the year 2023. Retrospective observational studies and clinical case reports of patients aged 9 to 93 years, undergoing beam computed tomography examination conical, there were no restrictions regarding year and language. Two reviewers performed data extraction and assessed the risk of bias of the included studies using the checklist proposed by AQUA (Anatomical Quality Assessment Tool of meta-analyses and systematic reviews). Three hundred and thirty-four published studies were found in the searches. Fifty-two studies were selected by titles and abstracts and 32 by reading the full text. Twenty-three manuscripts were included in the final analysis. Excluded studies are available upon request. The prevalence of sinuous canal varied from 36.2% to 100%. The diameter was reported to be greater than 1 mm bilaterally in the terminal portion of the palatal region, associated with the central incisor. There were no major differences reported regarding age or sex. Surgical complications can be intraoperative (bleeding) or postoperative: neurosensory changes, pain and failure in the osseointegration of dental implants.

Keywords: Anatomy, Maxillary Nerve; Cone-Beam Computed Tomography, Morphology, Prevalence, Dental Implants, Paresthesia.

INTRODUCTION

The sinuous canal of the maxilla is a tortuous intraosseous canal that extends from the infraorbital foramen, leads laterally towards the nasal cavity, and ends in the anterior alveolar region of the maxilla (KHOJASTEPOUR; AKBARIZADEH, 2023). It emerges from the posterior portion of the infraorbital foramen and runs below the inferior wall of the orbit and medially towards the anterior wall of the maxillary sinus. Furthermore, it transports the anterosuperior alveolar nerve and the vessels that irrigate the anterior maxilla (FERNANDES et al., 2022). This region has thin cortical bone, which makes it susceptible to invasion during surgical procedures (LA ENCINA et al., 2022). Accurate assessment of the SC and its extension to the alveolar ridge is essential to avoid incorrect diagnoses of periapical changes and invasion of this neurovascular structure. The SC is a common anatomical landmark but is often neglected due to a lack of knowledge of this structure by dental surgeons (ALVES et al., 2021).

Unaware of the existence and presence of SC, many dental surgeons identify this structure as a periapical radiolucency, and it is commonly interpreted as an apical pathology in the analyses of periapical radiographs (AHUMADA-TORDECILLA, 2021). Unawareness of this structure can lead to intra and postoperative consequences such as hemorrhages, algesia, paresthesia, hyperalgesia, dysesthesia and, in cases of implant surgery, failure in the osseointegration process (BRIDI et al., 2021). Cone beam computed tomography (CBCT) provides greater confidence to the surgeon and can help avoid inappropriate treatments or nerve injuries in the trans and postoperative phases (WANZELER et al., 2015). However, sinuous canal is poorly described in the literature and often goes unnoticed in image evaluations before procedures in the anterior region of the maxilla (ALVES et al., 2021).

The SC appears in imaging studies as a radiolucent or hypodense curvilinear canal that runs laterally through the pyriform opening, varying its path and end (AOKI, et al., 2020). Diagnostic imaging methods using panoramic and periapical radiographs provide a 2D, uniplanar image commonly used in routine dental procedures. However, these imaging tests are not sufficient to diagnose SC due to low image quality, overlapping magnifications, and distortions. Cone beam computed tomography (CBCT) is considered the gold standard for its diagnosis (ALKIS; ATA; TAS, 2023).

Within our search, two systematic reviews evaluated the topic (DE OLIVEIRA- NETO et al., 2023; FERLIN; PAGIN; YAEDÚ, 2019). The most recent of these, by De Oliveira-Neto et al. (2023), evaluated a total of 1994 individuals, finding the Sc in 80% of their sample (DE OLIVEIRA-NETO et al., 2023). According to Ferlin, Pagin, and Yaedú (2019), the SC has an average of 2 mm in diameter, in addition to variations in its path, location, and diameter.

Thus, this study is justified by the need to gather, update and disseminate knowledge about the prevalence and anatomical variations of CS and its possible complications.

METHODS

The reporting of this systematic review is based on the Preferred Reporting Items for Systematic and Meta-Analyses (PRISMA) guidelines (PAGE et al., 2021). The protocol was registered in PROSPERO (CRD42023458791).

Data sources and researches

The search strategy was developed by an experienced librarian specialist in health science databases. The search terms included a list of subject headings and keywords related to the concepts of canalis sinuosus. The search was conducted in six electronic databases: EMBASE, ISI Web of Science, SCOPUS, BIREME, LILACS, and PubMed. No restrictions were used for language or year of publication. The electronic researches were conducted in August 2023. The search strategy is provided in Supplementary Material S1. Additionally, a manual search and a Scopus track of the references of selected studies and other published systematic reviews were carried out in September 2023.

Study Selection

The inclusion and exclusion criteria for this review followed the Population, Intervention, Comparison, Outcome, and Study (PICOS) design described as follows:

Participants (population of interest)

Humans aged 09 to 93 years.

Exposion

Winding channel watched in TCFC

Comparison

A control group does not exist.

Outcomes

The main outcome is the prevalence of SC, its anatomical variations and surgical complications.

Data screening

Search results were compiled into ZOTERO software and imported into Covidence (www.covidence.org), which was used for screening the studies. The PRISMA flowchart was used to keep track of duplicates, included studies, and excluded studies. Two authors (S.C.F.G. and L.C.F.) screened the titles, abstracts, and full texts obtained in the search using the previously described inclusion and exclusion criteria. A third reviewer (E.B.P.) was consulted if a consensus could not be reached.

Data extraction

Data was extracted in an Excel file developed for this systematic review, which was pilot-tested by the team members before the data extraction started. The Excel sheet had drop-down menus, which helped to maintain the consistency of the extraction. The data extracted was based on the study characteristics (i.e., authors, design, publication details, sample size calculation), characteristics of the population (e.g., age, sex), canalis sinuosos location, among others. After finishing the data extraction, the information from each study was compiled into a Word file. Data extraction was carried out independently by one reviewer, and a second reviewer checked all data to ensure accuracy. Any disagreements on data extraction were resolved by consensus. Both reviewers received formal training to maintain the consistency of the data extraction process.

Quality assessment (Risk of Bias)

Primary studies were assessed with the Anatomical Quality Assessment (AQUA) tool. The evaluations will be carried out by two independent authors. Any disagreements between these authors were resolved through meetings and discussions to reach a consensus. A third, more experienced reviewer, was consulted to break ties if it was not possible to reach a consensus. The AQUA tool consists of five domains. The flag questions for each domain were answered with a “Yes”, “No” or “Unclear”, indicating low, high, and unclear risks of bias, respectively. When a domain's flagging questions were answered “Yes”, then the risk of bias was considered “Low”. When the signaling question was answered “No”, this indicated the potential for bias. “Unclear” was used only when the data communicated was insufficient to allow a clear judgment. When signaling questions could not be answered due to unreported or

missing information, the risk of bias was judged “High”.

Data synthesis and subgroup analysis

A narrative description of the results was performed. Studies with enough data that could be combined with other studies based on clinical characteristics were included in a meta-analysis.

Data analysis

Review Manager (RevMan) version 5.0 software (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark, 2008) was used to summarize the Risk of Bias evaluation. The software MetaXL 5.3 (EpiGear International, Queensland, Australia), was used to summarize the effects (i.e., pooled values) and construct the forest plot.

RESULTS

A total of 435 published studies were identified. After removing 334 duplicate records, 101 studies were screened for titles and abstracts, and 52 were selected for full-text reading. Therefore, after a detailed analysis of the full text of the selected studies, 23 manuscripts fulfilled the inclusion criteria and were included in the final analysis, as described in the PRISMA flowchart (Figure 2). The excluded studies as well as the individual reasons for exclusion are available upon request. Details of the included studies are provided in Supplementary Material I.

Figure 2. PRISMA flowchart of included and excluded studies.

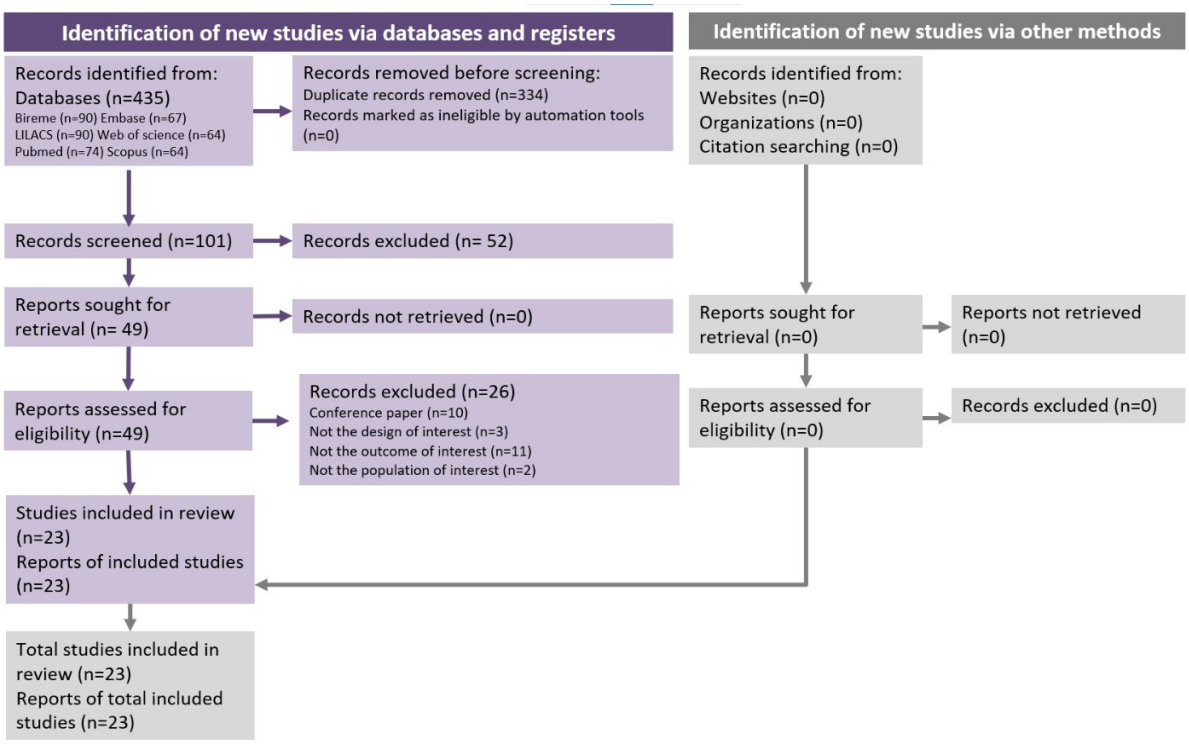

Table 1 summarizes the characteristics of each primary study included in this SR.

Table 1. General characteristics of included studies (n=23, 3.994 patients).

STUDY CHARACTERISTICS	N	STUDY CHARACTERISTICS	N
Country		**Founding**	
Brazil	8	Not reported	4
Turkey	3	No founding	15
Others	12	Founding	4
Language		**Sex**	
English	22	Male	7
Other	1	Female	7
		Mixed	9
Publication date		**Unilateral or Bilateral**	
Before 2015	2	Unilateral	8
Between 2015 and 2020	11	Bilateral	13
After 2020	10	Not reported	2
Study design		**Canalis Sinuosus Location**	
Observational	17	Dental Apex	4
Case	6	Adjacent to the dental apex	1
		Nasal Cavity	3
Ethical approval		Nasal Floor	2
Yes	14	Palate	6
Not reported	9	Not reported	7

Prevalence

The first aspect worth pointing out in this section is the prevalence of SC. Five studies (21.73%) reported a 100% prevalence of SC in their samples (ALKIS; ATA; TAS, 2023; ALVES et al., 2021; BAENA-CALDAS et al., 2019; LELLO et al., 2020; SAMUNAHMETOGLU; KURT, 2023). The present study also covered five reports of one case (ARRUDA et al., 2017; LOPES DOS SANTOS et al., 2020; NEVES et al., 2012; ROSANO et al., 2021; SANTOS et al., 2022) and reports of four cases (RUIZ GARCÍA DE CHACÓN; MAYANGA BECERRA, 2017) and three cases (SHINTAKU; FERREIRA; VENTURIN, 2020). Studies with a prevalence of less than 50% have been reported, Beyzade et al., 2022 in their sample of 188 CBCT showed a 48.4% prevalence, and Manhães Júnior et al., 2016 a 36.2% prevalence. La Encina et al.,

2022 and Yeap et al., 2022 demonstrated a prevalence of 99.1% and 98.5% respectively prevalence. Fernandes et al., 2022 and Wanzeler et al., 2015 in their analysis they discovered 82% and 88%. Still, five studies (21.73%) obtained results between 50% and 80%, being Anatoly et al., 2019; Khojastepour; Akbarizadeh, 2023; Machado et al., 2016; Sedov et al., 2019; Aoki et al., 2020, characterized the frequency as 67%, 78.35%, and 52.1%.

Age and Sex

Regarding age, the authors were unanimous in reporting that there was no difference (ALKIS; ATA; TAS, 2023; ALVES et al., 2021; ANATOLY et al., 2019; AOKI, et al., 2020; BAENA-CALDAS et al., 2019; BEYZADE et al., 2022; FERNANDES et al., 2022; KHOJASTEPOUR; AKBARIZADEH, 2023; LA ENCINA et al., 2022; LELLO et al., 2020; MACHADO et al., 2016; MANHÃES JÚNIOR et al., 2016; SAMUNAHMETOGLU; KURT, 2023; WANZELER et al., 2015; YEAP et al., 2022).

Male sex was more prevalent in two studies (8.69%) (LA ENCINA et al., 2022; MACHADO et al., 2016) and Anatoly et al. (2019) reported in their study a higher prevalence of SC in females, (8.69%) while the other authors reported that there was no difference between the sexes (ALKIS; ATA; TAS, 2023; ALVES et al., 2021; BEYZADE et al., 2022; FERNANDES et al., 2022; KHOJASTEPOUR; AKBARIZADEH, 2023; LELLO et al., 2020; MANHÃES JÚNIOR et al., 2016; SAMUNAHMETOGLU; KURT, 2023; SEDOV et al., 2019; WANZELER et al., 2015; YEAP et al., 2022). In the case reports included in the present study, there were nine female patients (ARRUDA et al., 2017; NEVES et al., 2012; ROSANO et al., 2021; RUIZ GARCÍA DE CHACÓN; MAYANGA BECERRA, 2017; SANTOS et al., 2022; SHINTAKU; FERREIRA; VENTURIN, 2020) and three male patients (LOPES DOS SANTOS et al., 2020; SHINTAKU; FERREIRA; VENTURIN, 2020).

Location

Regarding location, the majority of studies, thirteen (56,52%) indicated the presence of SC as bilateral (ALKIS; ATA; TAS, 2023; ALVES et al., 2021; ANATOLY et al., 2019; AOKI, et al., 2020; BAENA-CALDAS et al., 2019; BEYZADE et al., 2022; LA ENCINA et al., 2022; LOPES DOS SANTOS et al., 2020; MACHADO et al., 2016; NEVES et al., 2012; ROSANO et al., 2021; RUIZ GARCÍA DE CHACÓN; MAYANGA BECERRA, 2017; WANZELER et al., 2015). In eight studies (34.78%), the presentation of SC was described as unilateral (ARRUDA et al., 2017; FERNANDES et al., 2022; KHOJASTEPOUR; AKBARIZADEH, 2023; LELLO et al., 2020; MANHÃES JÚNIOR et al., 2016; SANTOS et al., 2022; SHINTAKU; FERREIRA; VENTURIN, 2020; YEAP et al., 2022), and two (8,69%) studies did not report this information

(SAMUNAHMETOGLU; KURT, 2023 SEDOV et al., 2019).

Associated teeth

The teeth associated with proximity to the SC were mostly central incisors, as demonstrated in eleven studies (47,82%) (ALKIS; ATA; TAS, 2023; ALVES et al., 2021; AOKI, et al., 2020; FERNANDES et al., 2022; LA ENCINA et al., 2022; MACHADO et al., 2016; ROSANO et al., 2021; RUIZ GARCÍA DE CHACÓN; MAYANGA BECERRA, 2017; SAMUNAHMETOGLU; KURT, 2023; WANZELER et al., 2015; YEAP et al., 2022). Shintaku, Ferreira, and Venturin (2020), in their study, highlighted a case associated with the central incisor and also a case associated with the lateral incisor and canine. Followed by the lateral incisor reported in six studies (26.08%) (ANATOLY et al., 2019; BEYZADE et al., 2022; KHOJASTEPOUR; AKBARIZADEH, 2023; MANHÃES JÚNIOR et al., 2016; NEVES et al., 2012; SANTOS et al., 2022). The canine was also reported in one study (4.34%) (ARRUDA et al., 2017) and four studies (17.39%) did not report proximity to teeth (BAENA-CALDAS et al., 2019; LELLO et al., 2020; LOPES DOS SANTOS et al., 2020; SEDOV et al., 2019).

Terminal portion

The end of the SC is another aspect to be discussed, six studies (26,08%) reported that the palatal region is the most prevalent area, (BEYZADE et al., 2022; MACHADO et al., 2016; MANHÃES JÚNIOR et al., 2016; NEVES et al., 2012; ROSANO et al., 2021; YEAP et al., 2022). However, Ruiz García de Chacón; Mayangoa Becerra, 2017 reported an adjacent tooth apex. The nasal cavity was also reported by Alves et al., 2021; La Encina et al., 2022; Lello et al., 2020, as the terminal portion of the SC. The nasal floor was also described by Lopes dos Santos et al., 2020; Wanzeler et al., 2015 and palate by Beyzade et al., 2022; Machado et al., 2016; Manhães Júnior et al., 2016; Neves et al., 2012; Rosano et al., 2021; Yeap et al., 2022. Four studies (17.39%) reported dental apex (ARRUDA; BAENA-CALDAS et al., 2019; SANTOS et al., 2022; SHINTAKU; FERREIRA; VENTURIN, 2020). Seven studies (30,43%) did not report the end of SC. (ALKIS; ATA; TAS, 2023; ANATOLY et al., 2019; FERNANDES et al., 2022; KHOJASTEPOUR; AKBARIZADEH, 2023; AOKI et al., 2020; SAMUNAHMETOGLU; KURT, 2023; SEDOV et al., 2019).

Diameter of the SC

The average diameter of the SC was described in ten studies (43,47%) as approximately 1 mm (ALKIS et al., 2023; ALVES et al., 2021; ANATOLY et al., 2019; BAENA-CALDAS et al., 2019; LELLO et al., 2020; MACHADO et al., 2016; MANHÃES

JÚNIOR et al., 2016; AOKI et al., 2019; SAMUNAHMETOGLU; KURT, 2023; WANZELER et al., 2015). Four studies (17.39%) reported the SC diameter to be less than 1 mm (BEYZADE et al., 2022; FERNANDES et al., 2022; KHOJASTEPOUR; AKBARIZADEH, 2023; LA ENCINA et al., 2022). Yeap et al., 2022 reported in their research a diameter of 1.50±0.43 mm. ARRUDA et al. (2017) demonstrated a diameter greater than 2 mm, and, seven studies (30.43%) did not report the diameter of the SC (LOPES DOS SANTOS et al. 2020;NEVES et al., 2012; ROSANO et al., 2021; RUIZ GARCÍA DE CHACÓN; MAYANGA BECERRA, 2017; SHINTAKU; FERREIRA; VENTURIN, 2020; SANTOS et al., 2022; SEDOV et al., 2019).

Surgical complications

The surgical complications reported by the authors were: hemorrhage (trans surgical); neurosensory changes (paresthesia, dysesthesia, hyperalgesia); neuropathic pain; non-bone integration of dental implants (ALKIS; ATA; TAS, 2023; AOKI, et al., 2020; BAENA-CALDAS et al., 2019; FERNANDES et al., 2022; KHOJASTEPOUR; AKBARIZADEH, 2023; LA ENCINA et al., 2022; LELLO et al., 2020; SAMUNAHMETOGLU; KURT, 2023; WANZELER et al., 2015).

Samunahmetoglu and Kurt (2023) reported epistaxis; and La Encina et al. (2022) reported changes in bone regeneration surgeries in the region; and Beyzade et al. (2022) reported subnasal swelling. In case reports, neurosensory changes were identified due to compression of the SC by dental implants (ROSANO et al., 2021; SHINTAKU; FERREIRA; VENTURIN, 2020). Five studies did not report surgical complications (21.73%) (ALVES et al., 2021; ANATOLY et al., 2019; MACHADO et al., 2016; SEDOV et al., 2019; YEAP et al., 2022).

Information about the objective of the study, country, sample details (sample size, sex, age), details of the sinuous canal (prevalence, terminal portion, related tooth, presentation, diameter), conclusions, and limitations will be presented in the following Table.

Table 2. Evidence table of the included reports (n=23, 3.994 patients).

Study	Population Details	Canalis Sinuosus Details	Conclusions and Limitations
ALKIS et al., 2023 **Country:** Türkiye **Aim:** To assess the presence of accessory canal associated with SC, describing their frequency, lateralization, location, direction, and measurements in CBCT.	**Sex:** Mixed **Sample Size:** The CBCT images of 109 (44%) male and 139 (56%) female **Age:** 18-78 years	**Prevalence:** 100% **Terminal Portion:** NR **Teeth:** Central incisors **Presentation:** Bilateral Diameter: >1mm	**Conclusions:** SC detected in all CBCT scans as bilaterally. Clinicians performing surgical procedures should keep in mind that anatomical variations of the vascular nerve bundle may be seen. M1, M2, and M3 measurements can be affected by gender, age, and dental status. **Limitations:** NR
ALVES et al., 2021 **Country:** Chile **Aim:** To determine the frequency of the Canal Sinuosus and its anatomical variations.	**Sex:** Mixed **Sample Size:** The CBCT images of 28, six of male individuals and 22 of females **Age:** 15-45 years	**Prevalence:** 100% **Terminal Portion:** Nasal Cavity **Teeth:** Central incisors **Presentation:** Bilateral **Diameter:** >1mm	**Conclusions:** The SC presents a diameter greater than 1.0 mm, which may vary over its course; it is greatest in the region of the bifurcation of the SC at the lateral margin of the pyriform aperture. Not affected by sex, side or age range and the terminal portion of the SC is usually in the nasal cavity. The terminal portion of AC to the SC is most frequently found between the upper central incisors, followed by the region of the upper lateral incisor. **Limitations:** NR
ANATOLY et al., 2019 **Country:** Russia	**Sex:** Mixed	**Prevalence:** 67% **Terminal Portion:** NR	**Conclusions:** CBCT examination demonstrated good diagnostic efficiency in SC visualization (67%). In addition, this study

Aim: investigate radiological and morphometric features of the canalis sinuosus in Russian population using CBCT technique.	**Sample Size:** 150 CBCT, 61 males and 89 females **Age:** 20-80 years	**Teeth:** Lateral incisors **Presentation:** Bilateral **Diameter:** >1mm	showed the importance of slice thickness choice for SC visualization. **Limitations:** NR
AOKI et al., 2019 **Country:** Brazil **Aim:** The main goal of the present study was to verify the presence, spatial location, the end of the canalis sinuosus.	**Sex:** Mixed **Sample Size:** 200 CBCT images, 107 (53.5%) women and 93 (46.5%) men **Age:** 18-85 years	**Prevalence:** 66.5% **Terminal Portion:** NR **Teeth:** Central incisors **Presentation:** Bilateral **Diameter:** >1mm	**Conclusions:** SC is an anatomical structure as most (66.5%) of the study population had SC. In addition, it was observed that there was a higher frequency of SC in male individuals, but no relationship with age. Gender and age did not influence diameter, location, and the end of the SC trajectory either. **Limitations:** NR
ARRUDA et al., 2017 **Country:** Brazil **Aim:** To report a case with the presence of canalis sinuosus.	**Sex:** Female **Sample Size:** 1 case **Age:** 51 years	**Prevalence:** Report 1 Case **Terminal Portion:** Dental Apex **Teeth:** Right upper canine **Presentation:** Unilateral	**Conclusions:** The application of CBCT is recommended to allow the possible identification of the SC and detail its anatomical location, diameter, length and variation, avoiding possible iatrogenic events in the placement of implants or other surgical procedures involving the region. **Limitations:** NR

		Diameter: 2 mm	
BAENA-CALDAS et al., 2019 **Country:** Colombia **Aim:** The objective of this work was to determine the frequency of Canalis Sinuosus (SC) and its anatomical variations case.	**Sex:** Mixed **Sample Size:** 236 CBTC, 130 of women (55 %) and 106 of men (45 %) **Age:** 9-93 years	**Prevalence:** 100% **Terminal Portion:** Dental Apex **Teeth:** NR **Presentation:** Bilateral **Diameter:** >1mm	**Conclusions:** The SC was visualized clearly in 100% of the images, observing channel variations in up to 46% of the cases. In 79% of the cases, the variation was bilateral. The most common variation was an increase in diameter (> 1 mm) of the SC. **Limitations:** NR
BEYZADE et al., 2022 **Country:** Türkiye **Aim:** Prevalence, and clinical relevancy of ACs of the SC in implant procedures in the Cypriot population with pre-acquired CBCT.	**Sex:** Mixed **Sample Size:** The CBCT images of 91 patients (52 males, 39 females) **Age:** 11-74 years	**Prevalence:** 48.4 % **Terminal Portion:** Palate **Teeth:** Lateral incisors **Presentation:** Bilateral **Diameter:** <1mm	**Conclusions:** Due to the presence the SC, pre-operative implant examinations should be carried out thoroughly with small-voxel sized CBCT devices. **Limitations:** NR
FERNANDES et al., 2022 **Country:** Indian **Aim:** To perform CBCT analysis in the Chennai population to check for the prevalence of the canalis	**Sex:** Mixed **Sample Size**: Out of the 100 CBCT **Age:** 18-65 years	**Prevalence:** 82% **Terminal Portion:** NR **Teeth:** Central incisors	**Conclusions:** The presence of the accessory canals of the SC in the site of implant placement in the anterior maxilla is relatively rare. The probability of its occurrence in the site of routine endosseous implant placement may be rare. However, the risk of iatrogenic damage to the nerve cannot be ruled out.

sinuosus and its terminal branches in the site of endosseous implant.		**Presentation:** Unilateral **Diameter:** <1mm	**Limitations:** NR
KHOJASTEPOUR E AKBARIZADEH, 2023 **Country:** China **Aim:** To evaluate the extension of canalis sinuosus into the alveolar crest for surgical reference in the anterior maxilla.	**Sex:** Mixed **Sample Size:** 485 CBTC, 228 (47.01%) male and 257 (52.99%) female **Age:** 38-50 years	**Prevalence:** 78.35%, unilateral (57.11%) and bilateral (42.89%) **Terminal Portion:** NR **Teeth:** Lateral incisors **Presentation:** Unilateral **Diameter:** <1mm	**Conclusions:** The frequency 78% and there was no significant difference between the sexes. SC was unilateral and the diameter was smaller than 1 mm, with no significant difference between the sexes. The most common mesiodistal location of SC was the lateral teeth. SC into the alveolar ridge in both horizontal and vertical directions was type II, which is not closest to the alveolar ridge, the third quadrant of the ridge from labial to palatal and from apical to incisal. **Limitations:** Its lack of evaluation of SC extension type in edentulous subjects compared to dentate patients. Extension type of SC may vary in different ethnic groups.
LA ENCINA et al., 2022 **Country:** Spain **Aim:** CBCT to analyze the prevalence of several maxillary anatomical/accessory structures, as well as variations within each type, assessing how accurate diagnosis can minimize the risk of intraoperative complications during	**Sex:** Mixed **Sample Size:** 212 CBTC, 95 men and 117 women **Age:** Not Reported	**Prevalence:** 99.1% **Terminal Portion:** Nasal cavity **Teeth:** Central incisors **Presentation:** Bilateral **Diameter:** <1mm	**Conclusions:** Within the limitations of the present study, it may be affirmed that the use of CBCT significantly increases the possibility of identifying anatomical variations and relationships in the maxilla, minimizing the risk of intraoperative complications during implant procedures. More than half of all patients present branches of the canalis sinuosus, which are more prevalent in men than women and are located mainly at the level of the incisors. **Limitations:** NR

implantological procedures in the oral cavit.			
LELLO et al., 2020 **Country:** Switzerland Aim: Analyses the course of the canalis sinuosus until its termination in the anterior maxilla and chart its anatomical relationship with surrounding structures using CBCT.	**Sex:** Mixed **Sample Size:** 100 CBCT scans of 62 females and 38 males **Age:** 21–82 years	**Prevalence:** 100% **Terminal Portion:** Nasal cavity **Teeth:** NR **Presentation:** Unilateral **Diameter:** >1mm	**Conclusions:** The rate of identification of the SC using CBCT was 100% in the present study, in comparison to other investigative modalities. **Limitations:** NR
LOPES DOS SANTOS et al., 2020 **Country:** Brazil **Aim:** Report a case of a patient who suffered pain due to exposure of the SC.	**Sex:** Male **Sample Size:** Report of 1 case **Age:** 79 years	**Prevalence:** Report 1 Case **Terminal Portion:** Nasal floor **Teeth:** NR **Presentation:** Bilateral **Diameter:** NR	**Conclusions:** This study focused on the SC, an often overlooked anatomical structure that may be the cause of dental implant failure. Most cases of injured SC were related to dental implant surgery; Preoperative CBCT scans would have prevented these injuries. **Limitations:** NR
MACHADO et al., 2016 **Country:** Brazil **Aim:** To verify the presence, spatial location, and caliber of the accessory canals of the canalis	**Sex:** Mixed **Sample Size:** This study evaluated 1.000 CBCT scans of 483 male, 517 female	**Prevalence:** 52.1% **Terminal Portion:** Palate **Teeth:** Central incisors	**Conclusions:** Males showed a statistically higher frequency of AC than females. The difference in age distribution was not statistically significant. Twenty percent of all AC presented a diameter of a least 1.0 mm. The end of the AC trajectory was found most frequently to be located palatal to the anterior maxillary teeth.

sinuosus by cone beam computed tomography.	**Age:** 20-60 years	**Presentation:** Bilateral **Diameter:** >1mm	**Limitations:** NR
MANHÃES JUNIOR et al., 2016 **Country:** Brazil **Aim:** The presence, location, and distance of the SC between the incisive foramen and the anterior alveolar ridge using CBCT.	**Sex:** Mixed **Sample Size:** 500 CBCT, female 284 patients, men 216 patients **Age:** 20-80 years	**Prevalence:** 36.2 % **Terminal Portion:** Palate **Teeth:** Left lateral incisor **Presentation:** Unilateral **Diameter:** >1mm	**Conclusions:** According to the results obtained here, it may be concluded that there is a variation in the location of the SC if compared to the crest and buccal cortical bone of the ridge, assuming that it is going to be located by the upper lateral incisor palatine. **Limitations:** NR
NEVES et al., 2011 **Country:** Brazil **Aim:** Case report on the presence of bilateral accessory duct.	**Sex:** Female **Sample Size:** Report of 1 case **Age:** 54 years	**Prevalence:** Report 1 Case **Terminal Portion:** Palate **Teeth:** Lateral incisors **Presentation:** Bilateral **Diameter:** NR	**Conclusions:** Identification of individual anatomical variations, especially with the CBCT, may help the surgeon avoid injuries to nerves during implant placement. **Limitations:** NR
ROSANO et al., 2021	**Sex:** Female	**Prevalence:** Report 1 Case	**Conclusions:** The customary 2-millimeter safety zone recommended above a bundle

Country: Italy **Aim:** This case report describes the management of an injury involving the SC.	**Sample Size:** Report of 1 case **Age:** 62 years	**Terminal Portion:** Palate **Teeth:** Central incisors **Presentation:** Bilateral **Diameter:** NR	could be extended to 4 mm Further studies with a higher level of evidence will be necessary to confirm these considerations. **Limitations:** NR
RUIZ GARCÍA DE CHACÓN E MAYANGA BECERRA, 2017 **Country:** Peru **Aim:** Report 4 cases of SC in asymptomatic patients from the Health Service.	**Sex:** Female **Sample Size:** Report of 4 cases **Age:** 39, 47, 62 and 55 years	**Prevalence:** Report 4 Cases **Terminal Portion:** Adjacent tooth apex **Teeth:** Central incisors **Presentation:** Bilateral **Diameter:** NR	**Conclusions:** As in this research, the female sex prevailed, while the right side housed the SC in 3 of the 4 cases presented. **Limitations:** NR
SAMUNAHMETOGLU E KURT, 2023 **Country:** Türkiye **Aim:** The study aims to determine the distribution, location, diameter, and distance measurements of	**Sex:** Mixed **Sample Size:** 181 (60.3%) male and 119 (39.7%) female subjects **Age:** 10-80 years	**Prevalence:** 100% **Terminal Portion:** Not reported **Teeth:** Right central incisor	**Conclusions:** The presence, location, and diameter of the ear canals of SC cannot be associated with a specific age group or gender. In addition, there is a large age range in the child to early adulthood group (<20 years). **Limitations:** The group of children to early adulthood was not categorized to smaller groups.

Canalis Sinusosus in relation with age and sex.		**Presentation:** NR	The distribution between age groups are not equal.
SANTOS et al., 2022 **Country:** Brazil **Aim:** To report a case of facial pain after the insertion of a dental implant due to compression of the Canalis Sinuosus.	**Sex:** Female **Sample Size:** Report of 1 case **Age:** 36 years	**Prevalence:** Report 1 Case **Terminal Portion:** Dental Apex **Teeth:** Lateral incisors **Presentation:** Unilateral **Diameter:** NR	**Conclusions:** The SC presence and its possible anatomical variations should be taken into account during pre-surgical planning in the anterior maxilla region. For this purpose, three-dimensional imaging exams such as CBCT are recommended. **Limitations:** NR
SEDOV et al., 2019 **Country:** Indian **Aim:** Study was to analyze SC prevalence in relation to the slice thickness and SC diameter according to CBCT scans.	**Sex:** Mixed **Sample Size:** 100 CTBCT, 39 males and 61 females **Age:** 46-81 years	**Prevalence:** 55% **Terminal Portion:** NR **Teeth:** NR **Presentation:** NR **Diameter:** >1mm	**Conclusions:** CBCT analysis showed that the highest SC prevalence was detected with the use of 0.5/1 mm slice thickness. As well, the higher SC diameter, the better is its visualization. **Limitations:** NR
SHINTAKU et al., 2020 **Country:** USA **Aim:** Report was to familiarize practicing dentists and specialists with the SC and its Acs.	**Sex:** Mixed **Sample Size:** 3 cases **Age:** 73-year-old white man 47-year-	**Prevalence:** Report 3 Cases **Terminal Portion:** Dental Apex	**Conclusions:** The region between the central and the lateral incisors was a predominant location. Openings in this region were closer to the alveolar crest than those between the lateral incisor and the canine. **Limitations:** NR

	old white woman 78-year-old white man	**Teeth:** incisors central, lateral, canine **Presentation:** Unilateral **Diameter:** NR	
YEAP et al., 2022 **Country:** Australia **Aim:** To investigate SC in the anterior maxilla and describe its characteristics that may impact on surgical procedures in this region.	**Sex:** Mixed **Sample Size:** 201 CBCT, 118 females (58.7%), 83 male (41.3%) **Age:** 17-91 years	**Prevalence:** 98.5% **Terminal Portion:** Palate **Teeth:** Central Incisor **Presentation:** Unilateral **Diameter:** 1,50 ± 0,43 mm	**Conclusions:** SC was very common in the anterior maxilla. Clinicians would be well advised to identify this anatomical structure using CBCT before undertaking any surgery in the anterior maxilla. **Limitations:** NR
WANZELER et al., 2015 **Country:** Brazil **Aim:** To identify and describe the morphology and location of the (SC) and make correlations with gender, age, and distance of this canal to important adjacent structures on the region, thus	**Sex:** Mixed **Sample Size:** 100 CBCT, 31 male and 69 female **Age:** Not reported	**Prevalence:** 88% **Terminal Portion:** Nasal floor **Teeth:** Central incisor **Presentation:** Bilateral	**Conclusions:** In the sample, SC was frequent and similar in both genders, with course distance to the alveolar bone crest and termination in different locations that ought to be analyzed on CBCT before surgical procedures. **Limitations:** NR

mapping the anatomy of this structure.		**Diameter:** >1mm	

Legend: SC Sinuous Canal; CBCT Cone Beam Computed Tomography; USA United States of America; ACS Accessory Channels; NR Not Reported

The forest plot of SC prevalence is shown in Figure 2.

The figure shows the meta-analysis of the quality effects model showed a pooled prevalence of SC of 0.78 (95% CI 0.56–0.95; p=0.001; I2= 99%).

Figure 3. Forest plot of the prevalence of canalis sinuosus. Prev, prevalence; CI, confidence interval; I2, Higgins test; Q, CochranQtest.

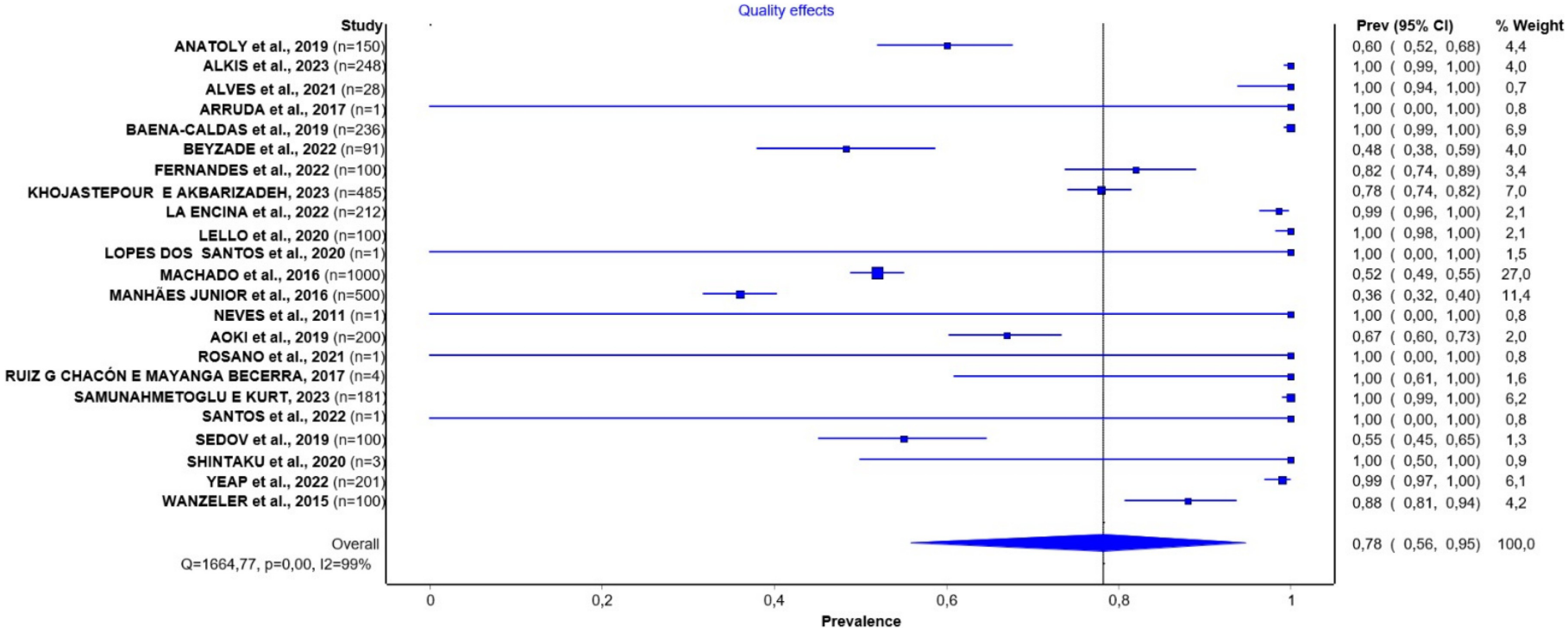

Figure 4 demonstrates the risk of bias divided into domains (Domain 1: objective and characteristics of the subject; Domain 2: study design; Domain 3: characterization of methods; Domain 4: descriptive anatomy; Domain 5: reporting results). Most studies presented a low risk of bias in domains 1 and 2. Domains 3, 4, and 5 presented an unclear risk of bias. No article presented a high risk of bias.

Figure 4. Risk of bias assessment of individual studies using the Anatomical Quality Assessment (AQUA) tool. Domain 1: objective and characteristics of the subject; Domain 2: study design; Domain 3: characterization of methods; Domain 4: descriptive anatomy; Domain 5: reporting results.

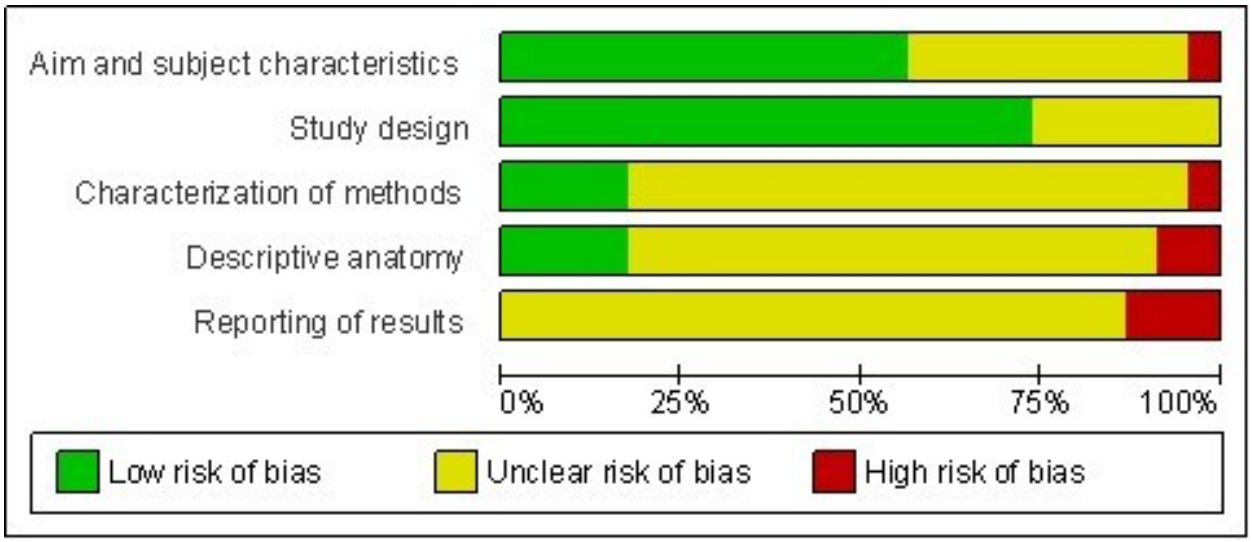

Figure 5 shows the risk of bias for each study. Domains 1 and 2 had the lowest risk of bias. Domains 3, 4 and 5 were mostly unclear. The domains that presented a high risk of bias were domain 1 and 3 in only one study each, domain 4 in two studies, and domain 5 in 3 studies.

Figure 5. Risk of bias divided by study.

DISCUSSION

This systematic review aimed to show the prevalence of the maxillary sinuous canal through the results of 23 included studies, in which, 3994 patients were analyzed. The prevalence of maxillary SC ranged from 36.2% to 100%. Wanzeler et al. (2015) reported that the SC was present in 88% of cases in the Brazilian population, with greater frequency bilaterally. A similar percentage was described by Fernandes et al. (2022), who found a total presence of SC in 82% of the Indian population; however, unilateral presence was more common than bilateral. Yeap et al. (2022) reported finding a frequency of 98.5% for the presence of SC in the Australian population. Aoki et al. (2020) said that the high percentage of SC presence shows that it is a normal anatomical structure and not an anatomical variation, as previously classified by Jones (1939), who was the first author to report SC in the literature. Therefore, it must be taken into consideration when planning treatments in the anterior region of the maxilla to avoid iatrogenic injuries during or after procedures in this region.

Dental procedures are frequently carried out in this region, and it is also susceptible to complications during or after the treatment of pathologies and surgeries in the region. The patient may experience pain, dysesthesia, hyperesthesia, or paresthesia due to exposure/compression of the SC by filling materials (Lopes dos Santos et al., 2020) or during the insertion of integrable bone implants, which, in addition to neurosensory changes, may present failure in the osseointegration process (SHINTAKU; FERREIRA; VENTURIN, 2020).

Manhães Júnior et al. (2016) and Wanzeler et al. (2015) reported no differences between sexes or sides for the terminal portion of the SC.

In the present study, 23 articles were included, which demonstrated the prevalence of SC. Ferlin, Pagin, and Yaedú (2019) in their systematic review included 11 articles, 9 of which were studies analyzing the prevalence of SC using CBCT. De Oliveira-Neto et al. (2023) included 17 articles in their study. Both demonstrate the SC as a prevalent anatomical structure, as it is present in most people and must be analyzed before surgical and endodontic procedures.

Regarding diameter, previous systematic reviews (DE OLIVEIRA-NETO et al., 2023a; FERLIN; PAGIN; YAEDÚ, 2019) corroborate the present study regarding the variation in the SC diameter between 1mm and 2mm. (BEYZADE et al., 2022; FERNANDES et al., 2022; KHOJASTEPOUR; AKBARIZADEH, 2023). However, the literature contains some studies that report the SC diameter as less than 1mm (LA ENCINA et al., 2022).

The systematic reviews already published did not include clinical cases in their data. The present study included clinical cases, given the description of signs and symptoms associated with SC compression. Shintaku, Ferreira, and Venturin, (2020) reported three clinical cases of SC invasion by dental implants. Both patients presented neurosensory changes in the anterior region of the maxilla, where they had previously been rehabilitated with osseointegrable implants. Lopes Dos Santos et al. (2020) in their clinical case, reported neuropathic pain without an apparent cause in a patient with complete upper edentulous who was using a complete upper prosthesis. The CBCT examination revealed bilateral SC, close to the incisor/canine region. The patient was referred for rehabilitation with dental implants, and the surgeons were informed about the presence of the sinuous canal (LOPES DOS SANTOS et al., 2020). In the case reported, the patient presented with paresthesia after the installation of a dental implant in the region corresponding to the upper right lateral incisor. In a CBCT examination, compression of the SC by the dental implant was diagnosed. Similarly, Rosano et al. (2021) reported pain after the installation of an implant in the region of the upper central incisor. In postoperative CBCT, compression of the SC by the dental implant was diagnosed, and complete sensory recovery occurred within 30 days after removal of the implant.

The correct identification and interpretation of CBCT images avoids several complications, which can range from hemorrhages to neurosensory changes or pain when related to compression of neurovascular structures. This review provides dental surgeons with scientific data that can support safer surgical and non-surgical dental procedures, in addition to highlighting the importance of correct planning when installing dental implants. Morphological knowledge, with the evidence provided, has the potential to improve success rates and reduce accident and complication rates. This way, the surgeon will have greater technical and scientific knowledge and, therefore, will be able to plan and execute procedures more safely.

Strengths and limitations

In this review, articles were edited systematically, and data extraction was carried out in pairs. The study updates information on the prevalence, topographic location, and morphometric characteristics of SC, assisting the dental surgeon in planning and executing procedures and preventing trans and postoperative complications. Also providing, through this information, the prevention of mistaken diagnosis, periapical pathologies, and internal and external resorption. The scientific data provided in this study may result in safer surgical procedures.

This systematic review has certain limitations due to the high heterogeneity of the included studies and unreported information, which are less common in longitudinal studies but are typical of cross-sectional studies. The heterogeneity of the members of the research group may have arisen for clinical, methodological, and statistical reasons. Clinical heterogeneity may have occurred due to the diversity of patients, different age groups, and different approaches to the results and the methods used to analyze them. Methodological diversity was observed due to the considerably different scores using the AQUA tool. The two aforementioned potential sources of heterogeneity together lead to statistical heterogeneity. The nature of the included studies should also be considered as a limitation. However, prevalence can only be addressed if a cross-sectional analysis is carried out; therefore, despite the intrinsic limitations due to the nature of the studies included, its design was still the best way to answer the focus question of this systematic review.

Clinical complications

By illustrating the scientific data exposed in this systematic review, professionals will have fundamental information about the presence, characteristics and topographic location of SC, supporting the planning and execution of dental procedures in the anterior region of the maxilla appropriately and acting preventively against possible trans (bleeding) and postoperative complications (pain, paresthesia, hyperalgesia, dysesthesia, failure in the bone integration process of dental implants). In cases where, after patients undergo procedures in this region, such as, for example, installation of dental implants, endodontic procedures, or use of complete dentures (in which the presence of SC was not previously diagnosed), they present neurosensory changes without an apparent cause, investigating the presence and possible compression of the SC is a valid option, as demonstrated in the literature, for the correct diagnosis and resolution of the case.

Research complications

This study presents recent scientific evidence about SC through a systematic review, as well as imaging aspects for detecting this structure, its prevalence (age and sex of patients), anatomical variations, topographic location (related tooth, terminal portion, diameter), and surgical complications. Providing the dental surgeon with a greater scientific basis and an update regarding this structure.

Future directions

The systematic literature review provided important information about the prevalence, location, and morphological characteristics of SC, bringing knowledge of this structure to dental surgeons, but also led to other questions that can be addressed in future research, such as: What is the prevalence of SC in patients with edentulism? What are the prevalence and main symptoms related to SC compression?

CONCLUSION

The prevalence of SC ranged from 36.2% to 100%. The diameter was reported in most studies as greater than 1 mm, bilaterally, in the terminal portion of the palatal region, associated with the central incisor. There were no major differences in relation to age or sex. Surgical complications can be intraoperative (hemorrhages) or postoperative: paresthesias, algesia, hyperalgesia, dysesthesia, failure in the osseointegration process of dental implants.

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CONCLUSÃO

Os resultados do presente trabalho reforçam a prevalência do CS. Essa estrutura apresenta variações quanto a localização, diâmetro e curso. Não foram relatadas diferenças em relação à idade ou sexo. O diâmetro médio variou entre 1mm a 2 mm. O dente mais comumente relacionado é o incisivo central superior e a porção teminal, na região palatina. Imaginologicamente, se apresenta como uma imagem radiolucida/hipodensa, sendo por muitas vezes confundidas com alterações periapicais e reabsorções internas e externas, levando a intervenções desnecessárias. Esse conhecimento anatomico é de fundamental importância tanto para o clínico quanto para o especialista, evitando complicações trans operatórias como hemorragias e pós operatórias como dor crônica, parestesias, disestesias e hiperestesias bem como o correto planejamento e execução de tratamentos, tanto endodônticos quanto cirúrgicos.

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APÊNDICE 1

METODOLOGIA DETALHADA

2.1 Artigo 1 - Prevalence and location of the canalis sinuosus and its anatomical variations using cone beam computed tomography: a systematic review.

O protocolo desta revisão sistemática foi desenvolvido, seguindo recomendações do PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) e o protocolo do estudo foi registrado no PROSPERO (*Prospective Register of Systematic Reviews*), disponível sob o número de registro CRD42023458791 (Anexo 1). Ainda, a presente revisão sistemática cumpriu os requisitos da lista de verificação do PRISMA.

A questão levantada para a realização desta revisão foi: “Qual a prevalência e localização do canal sinuoso e suas variações anatômicas utilizando a tomografia computadorizada de feixe cônico?”. Assim, essa mesma pergunta foi utilizada para estabelecer uma estratégia de busca apropriada para cada um dos seguintes bancos de dados eletrônicos com o apoio de um bibliotecário de ciências da saúde: EMBASE, ISI Web of Science, SCOPUS, BIREME, LILACS, e PubMed. As estratégias de busca utilizadas para cada base de dados mencionada anteriormente se encontram no anexo 2 desta tese.

Todas as referências foram gerenciadas pelo *software* COVIDENCE (*Level 10, 446 Collins St, Melbourne VIC 3000, Australia ABN: 41 600 366 274*) e os artigos duplicados foram removidos. Não houve restrições quanto ao idioma ou período de publicação.

Critérios de elegibilidade

Foram incluídos estudos que avaliaram a detecção e a prevalência Canal Sinuoso (CS) da maxila, utilizando tomografia computadorizada de feixe cônico

(TCFC). Foram excluídas, revisões, cartas e opiniões pessoais.

Seleção de estudos e coleta de dados

Foram encontrados 435 artigos após a aplicação das estratégias de busca, restando 334 após a aplicação da ferramenta para remoção de artigos duplicados. Para a seleção dos artigos, foi adotado um processo em duas fases. Primeiramente, dois revisores (S.C.F.G e L.C.F) leram os títulos e resumos dos artigos encontrados de acordo com as estratégias de busca. Assim, 101 artigos (estudos de prevalência e relatos de caso) foram triados para títulos e resumos e 52 foram selecionados para leitura na íntegra, sendo o restante excluídos por serem revisões, cartas, opiniões pessoais. Vinte e três artigos preencheram os critérios de inclusão. Os dois revisores (S.C.F.G e L.C.F) realizaram a seleção dos estudos e a coleta de dados de forma independente. Um terceiro (E.B.P) foi consultado em caso de discordância entre o primeiro e o segundo revisor.

Para extração de dados, inicialmente, dois revisores (S.C.F.G e L.C.F) coletaram os dados de forma independente e os compararam posteriormente.

As seguintes informações foram coletadas: autor, ano, país, tamanho da amostra, sexo, ano da publicação, objetivo do estudo, prevalência, porção terminal, dente relacionado, diâmetro, limitações e principais conclusões dos autores.

Análise de risco de viés em cada artigo selecionado

A qualidade metodológica dos estudos incluídos foi avaliada usando a ferramenta de risco de viés AQUA (*Anatomical Quality Assessment Tool of meta-analyses and systematic reviews* (Anexo 2)). A avaliação dos artigos foi realizada por três revisores (S.C.F.G, L.C.F e E.B.P) Os artigos foram classificados de acordo com a proporção de “alto” que receberam em cada item do AQUA: risco de viés alto (até 49%), moderado (50-69% pontuação “sim”) e baixo (>70% pontuação “sim”) (Anexo 3). Além disso, a ferramenta *RevMan (ReviewManager)* (Visualização de risco de viés) foi usada para gerar as figuras do presente estudo.

Síntese dos resultados

A heterogeneidade dos estudos foi avaliada com base nas suas características, características das metodologias e dos resultados. Todos os estudos incluídos apresentaram os dados coletados.

Estratégias de busca

***PubMed**: (("canalis sinuosus" OR "accessory canal" OR "infraorbital canal" OR "Alveolar anterosuperior") AND " cone beam computed tomography").*

***SCOPUS:** {canalis sinuosus} OR {accessory canal} OR {infraorbital canal} OR {Alveolar anterosuperior} AND { cone beam computed tomography})*

***Web of Science:** (("canalis sinuosus" OR "accessory canal" OR "infraorbital canal" OR "Alveolar anterosuperior") AND " cone beam computed tomography")*

***EMBASE:** (("canalis sinuosus" OR "accessory canal" OR "infraorbital canal" OR "Alveolar anterosuperior") AND " cone beam computed tomography")*

***LILACS:** (("canalis sinuosus" OR "accessory canal" OR "infraorbital canal" OR "Alveolar anterosuperior") AND " cone beam computed tomography")*

ANEXO 1 – Submissão do artigo Verificação de originalidade e prevenção de plágio

ESTUDO DA PREVALÊNCIA DO CANALIS SINUOSUS DA MAXILA EM TOMOGRAFIA COMPUTADORIZADA DE FEIXE CÔNICO: REVISÃO SISTEMÁTICA E META-ANÁLISE

RELATÓRIO DE ORIGINALIDADE

17%	14%	17%	1%
ÍNDICE DE SEMELHANÇA	FONTES DA INTERNET	PUBLICAÇÕES	DOCUMENTOS DOS ALUNOS

FONTES PRIMÁRIAS

1	O.B. de Oliveira-Neto, F.T. Barbosa, F.J.C. de Lima, C.F. de Sousa-Rodrigues. "Prevalence of canalis sinuosus and accessory canals of canalis sinuosus on cone beam computed tomography: a systematic review and meta-analysis", International Journal of Oral and Maxillofacial Surgery, 2022 Publicação	4%
2	www.researchgate.net Fonte da Internet	4%
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5	Jonua Fernandes, Subhasree Rohinikumar, Thiyaneswaran Nessapan, Dimple Rani, Rajendra Prabhu Abhinav, Priyalochana Gajendran. "CBCT Analysis of Prevalence of	1%

ANEXO 2 – Registro da Revisão Sistemática (PROSPERO)

CRD42023458791	Prevalence and location of the sinuous canal and its anatomical variations using cone beam computed tomography? To enable PROSPERO to focus on COVID-19 registrations during the 2020 pandemic, this registration record was automatically published exactly as submitted. The PROSPERO team has not checked eligibility.	Registered	09/09/2023

Disponível em: https://www.crd.york.ac.uk/PROSPERO/#myprospero

ANEXO 3 – Ferramenta de risco de viés AQUA

List of Domains with their Signaling Questions and Risk of Bias Judgment as Included in the Revised Version of the AQUA Tool

Domains & Questions	Options		
	Yes	No	Unclear
Domain 1: OBJECTIVE(S) AND SUBJECT CHARACTERISTICS			
Was (Were) the objective(s) of the study clearly defined?			
Was (Were) the chosen subject sample(s) and sample size appropriate for the objective(s) of the study?			
Are the baseline and demographic characteristics of the subjects (age, sex, ethnicity, healthy or diseased, etc.) appropriate and clearly defined?			
Could the method of subject selection have in any way introduced bias into the study?	RISK: LOW/HIGH/UNCLEAR		
Domain 2: STUDY DESIGN			
Does the study design appropriately address the research question(s)?			
Were the materials used in the study appropriate for the given objective(s) of the study?			
Were the methods used in the study appropriate for the given objective(s) of the study?			
Was the study design, including methods/techniques applied in the study, widely accepted or standard in the literature? If "no", are the novel features of the study design clearly described?			
Could the study design have in any way introduced bias into the study?	RISK: LOW/HIGH/UNCLEAR		
Domain 3: METHODOLOGY CHARACTERIZATION			
Are the methods/techniques applied in the study described in enough detail for them to be reproduced?			
Was the specialty and the experience of the individual(s) performing each part of the study (such as cadaveric dissection or image assessment) clearly stated?			
Are all the materials and methods used in the study clearly described, including details of manufacturers, suppliers etc.?			
Were appropriate measures taken to reduce inter- and intra-observer variability?			
Do the images presented in the study indicate an accurate reflection of the methods/techniques (imaging, cadaveric, intraoperative, etc.) applied in the study?			
Could the characterization of methods have in any way introduced bias into the study?	RISK: LOW/HIGH/UNCLEAR		
Domain 4: DESCRIPTIVE ANATOMY			
Were the anatomical definition(s) (normal anatomy, variations, classifications, etc.) clearly and accurately described?			
Were the outcomes and parameters assessed in the study (variation, length, diameter, etc.) appropriate and clearly defined?			
Were the figures (images, illustrations, diagrams, etc.) presented in the study clear and understandable?			
Were any ambiguous anatomical observations (i.e., those likely to be classified as "others") clearly described/depicted?			
Could the description of anatomy have in any way introduced bias into the study?	RISK: LOW/HIGH/UNCLEAR		
Domain 5: REPORTING OF RESULTS			
Was the statistical analysis appropriate?			
Are the reported results as presented in the study clear and comprehensible, and are the reported values consistent throughout the manuscript?			
Do the reported numbers or results always correspond to the number of subjects in the study? If not, do the authors clearly explain the reason(s) for subject exclusion?			
Are all potential confounders reported in the study, and subsequently measured and evaluated, if appropriate?			
Could the reporting of results have in any way introduced bias into the study?	RISK: LOW/HIGH/UNCLEAR		

ANEXO – SUPPLEMENTARY MATERIAL

Exclusion and inclusion criteria

INCLUSION	EXCLUSION
Retrospective Observational Studies Case Reports Humans aged 09 to 93 years, of age who underwent cone beam computed tomography examination	Review articles Book chapters Ummaries of conferences Letters to the editor Studies that did not use CBCT Expert opinions

ANEXO 5 – Submissão do artigo

Submission Confirmation for STUDY OF CANALIS SINUOSUS OF THE MAXILLA IN CONE BEAM COMPUTERIZED TOMOGRAPHY AND SURGICAL IMPLICATIONS SYSTEMATIC REVIEW AND META-ANALYSIS

1 mensagem

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