

# REVISTA DE PATOLOGIA DO TOCANTINS

## ETIOPATHOGENIC ASPECTS OF ODONTOGENIC MAXILLARY SINUSITIS OF PERIAPICAL ORIGIN

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**Abstract:**

Anatomically, the roots of the upper premolar and molar teeth are near the maxillary sinuses. Thus, periapical inflammation of the elements close to the sinuses enables the formation of odontogenic sinusitis. This study aimed to analyze the available literature on the etiopathogenic aspects of odontogenic maxillary sinusitis of periapical origin. A literature review was conducted in the following databases: SciELO, MEDLINE/Pubmed, and LILACS, using the keywords "Maxillary Sinusitis", "Dentistry", "Tooth" and "Infection". Articles written in English, Spanish, and Portuguese were included; those that fit the focus of the paper and those that were most relevant in terms of outlining the desired information. Papers reporting odontogenic sinusitis arising from an operative process were excluded. Odontogenic maxillary sinusitis (OMS) occurs due to sinus infection caused by inflammation of one or more dental elements near this cavity. Despite presenting specific features, sinusitis of odontogenic and non-odontogenic origin are quite similar, making the differential diagnosis difficult. Cone-Beam Computed Tomography (CBCT) is considered the reference standard for diagnosis, and the best treatment is to eliminate the causal factor. It was also found that apical periodontitis is the main non-iatrogenic cause and premolars and molars are the most affected teeth due to their anatomical location near the maxillary sinuses. The anatomical location of the maxillary sinus and the roots of the molars and premolars will allow, through the proximity between them, the OMS. In cases where periodontitis has proven to be the most frequent non-iatrogenic cause of this condition, also due to a great symptomatological similarity with non-odontogenic sinusitis, complementary examinations such as CBCT are necessary. Moreover, the treatment can be performed in a case-specific manner, through accurate diagnosis and etiopathogenesis.

**Keywords:** Sinusitis, Maxillary; Dentistry; Tooth; Infection.

**INTRODUCTION**

The maxillary sinuses are bilateral bony cavities filled with air and lined by a sinus membrane, containing bony septa inside. They are located above the premolar teeth and upper molars. They are considered to be the largest sinuses of the face among the frontal, ethmoidal and sphenoidal sinuses. Inflammation of the sinus membrane covering the paranasal cavity is referred to as maxillary sinusitis and its origin is mainly nasal<sup>1</sup>.

In some cases, the etiopathogenesis of maxillary sinusitis is odontogenic, corresponding to 10% to 12% of maxillary sinusitis. This sinusitis may be triggered by the presence of an infectious process in the root apices when communication occurs between the oral cavity and the maxillary sinus<sup>2</sup>. Odontogenic sinusitis may be silent, without the presence of symptoms, but may present with symptoms similar to non-odontogenic sinusitis, such as nasal obstruction or congestion, facial pain or pressure, and headaches. However, when the origin is odontogenic, these symptoms manifest on only one side of the face. In addition, other symptoms such as eye pain, postnasal drip, bad odor, and pain of dental origin have also been reported<sup>3</sup>. Typical endodontic symptoms, such as thermal pain, edema, and/or intraoral sinus tract drainage, are usually absent. As the periapical infection drains into the sinus through the fistula, periapical sensitivity may be absent<sup>4</sup>.

In addition, there is a difference regarding microbiology, pathophysiology, and management of sinusitis of nasal origin. Thus, defining the etiology of the disease is

essential for the proper treatment of odontogenic sinusitis to avoid its more severe manifestations, such as orbital cellulitis and brain abscess, which can lead to death<sup>5</sup>.

The etiology of sinusitis of the maxillary sinuses is dyskinesia in the ciliated stratified epithelial tissue in the nasal fossae, which causes the secretions produced to be directed to the nasopharynx, preventing them from entering the bone between the nasal fossae and the maxillary sinus, generating an infectious process. In the case of odontogenic sinusitis, the process is triggered by irritation or fracture in the sinus membrane, composed of connective tissue and also covered by ciliated stratified epithelial tissue<sup>6</sup>.

OMS is caused by untreated carious lesions, pulpal infection, pulpal necrosis, and trauma. Iatrogenesis and apical periodontitis are shown to be the major causes of this condition<sup>6</sup>. In the initial inflammation, the neutrophils present in the apical periodontitis picture, resulting from the inflammatory response in their defense mechanisms release prostaglandins in the affected area, which triggers the action of osteoclasts, deteriorating the surrounding bone, which subsequently, in chronic periapical periodontitis, on radiographs comes to be characterized by a radiolucent area<sup>4</sup>.

This bone deterioration can lead to extensive loss of the surrounding alveolar bone and involve the floor of the maxillary sinus or move it upward, generating a periosteal reaction, and subsequently a periodontal osteoperiostitis, thus, odontogenic maxillary sinusitis begins<sup>6</sup>. Changes in the sinus membrane have as main causes: apical periodontitis, dental infection, a trauma in the maxilla, presence of foreign objects, acquired pathologies, implants, supernumerary teeth, periapical granuloma, keratocysts, tooth extractions and orthognathic surgeries<sup>3</sup>.

Communication between the oral cavity and the maxillary sinus, also known as the oroantral fistula, is the main cause of OMS. The teeth most involved in the process leading to odontogenic sinusitis are the second premolars, and first and second molars, due to their proximity to the floor of the maxillary sinus<sup>4</sup>.

The diagnosis of odontogenic sinusitis involves a detailed and careful history taking into account the recent dental history involving the maxillary tooth and the patient's complaint corresponding to the symptoms associated with maxillary sinusitis. In addition to a well-performed extraoral and intraoral physical examination. In addition, the use of complementary imaging examinations can provide valuable information such as radiopaque features<sup>4</sup>.

Treatment of OMS will vary depending on the causative agent, it may include extraction of a supernumerary or infection and inflammation-related tooth, periodontal treatment, management of sinus infection and congested areas, non-surgical endodontic therapy, reimplantation, and periradicular surgery. If the causative factor is not treated, there is a possibility of recurrence<sup>4</sup> and endoscopies of the maxillary sinus are also promoted to clean the infected bone stores<sup>3</sup>.

In some cases, especially mucosa retention cysts, the Caldwell-Luc sinusotomy technique is used, in which an opening is made in the sinus to access the internal areas and drain the retained mucosa. In addition, antibiotic therapy is recommended. The condition is easily treated by these techniques and the removal of the causative factor. When the procedures are performed well, the literature shows low recurrence rates<sup>3</sup>.

## **METHODOLOGY**

This study is an integrative literature review. The research question for the development of the review was: "What are the aspects of the etiopathogenesis of maxillary sinusitis of odontogenic origin?"

The survey of scientific articles was carried out in October 2022 in the databases Scientific Electronic Library Online (SciELO), Medical Literature Analysis and Retrieval System Online (MEDLINE/Pubmed) e *Literatura Latino - Americana e do Caribe em Ciências da Saúde* (LILACS), using the combination of keywords: "Maxillary Sinusitis", "Dentistry", "Tooth", and "Infection". After searching the databases, the results were compared to exclude duplicates.

Articles published between 2012 and 2022, available in full in Portuguese, English, or Spanish, were included. The overall combination of data from the included studies was performed through descriptive synthesis.

## **RESULTS AND DISCUSSION**

The maxillary sinuses vary in size and shape in each individual or even between the right and left sides of the same individual. The sinus has a floor that extends into the alveolar process of the maxilla. The roots of the premolar teeth, molars, and upper canines have a greater proximity to the sinus, and may even be inside it<sup>7</sup>.

OMS occurs by infection of the sinuses due to an inflammation in a dental element near the sinus. The OMS represents 25-40% of all chronic sinusitis, affects women and men equally, and is most prevalent in the fifth decade of life<sup>8</sup>. Lechien et al.<sup>6</sup> state that

maxillary sinusitis of odontogenic origin is most prevalent between the ages of 30 and 50 years, but disagree when reporting that it affects women slightly more than men.

## Etiology

The OMS has several causes such as iatrogenic, marginal periodontitis, apical periodontitis, apical granuloma, odontogenic cyst, odontoma, ectopic tooth, and peri-implantitis. Among these etiologies, the most prominent are those of iatrogenic origin, with 65.7% of the cases being the main cause, while apical periodontitis (apical periodontitis, apical granulomas, and odontogenic cysts) showed 25.1%, and marginal periodontitis 8.3%, peri-implants, ectopic tooth, and odontoma were rare causes<sup>6</sup>.

Akhlaghi et al.<sup>9</sup> reported that oroantral fistula was the most common etiology found generating SMO, in sequence came chronic apical periodontitis as the second most common cause. Anaerobic microbiota is the most prevalent cause of chronic odontogenic sinusitis, in contrast, mixed microbiota is predominant in cases of acute sinusitis. Where in acute odontogenic maxillary sinusitis, Gram-negative bacilli, *Peptostreptococcus*, and *Fusobacterium spp* are the prevalent bacterial population. In such a way, Lechien et al.<sup>6</sup> described similar results. In his studies, Akhlaghi et al.<sup>9</sup> suggests through microbiological data that

## Symptomatology

Clinically, odontogenic maxillary sinusitis presents variably with the most common symptoms being facial pain or pressure, postnasal drip, nasal congestion, purulent anterior rhinorrhea that may be unilateral, foul odor and/or taste, and fatigue. Obtaining a complete history, particularly about dentoalveolar surgery, is critical. Of note is the finding that toothache is usually absent in odontogenic sinusitis, and when a toothache is present in the absence of other nasal symptoms, it is not specific to sinusites<sup>3</sup>.

Importantly, less than half of the patients report a recent dental procedure. This is probably due to the latency period of up to one year for maxillary sinusitis associated with augmentative dental surgery and a latency of almost four years in implant-associated maxillary sinusitis. Careful evaluation of the dentition for root fractures, dental pulp condition, periodontal tissues, the presence of an oroantral fistula, and the condition of existing dental restorations are important components of the initial physical examination. In addition, intranasal examination with anterior rhinoscopy or nasal endoscopy may

demonstrate findings of unilateral purulent rhinorrhea or edema but remains less sensitive in detecting odontogenic sinusitis compared to imaging modalities<sup>3</sup>.

### **Complementary exams**

For the differential diagnosis of sinusitis of odontogenic origin, intra and extraoral radiographs are indicated, as well as a good anamnesis, to identify dental factors associated with the inflammatory/infectious process, which may allow the access of microorganisms to the cavity, such as caries, periapical diseases, iatrogenesis, oroantral fistulas and odontogenic cysts<sup>3,10</sup>. Sato et al.<sup>11</sup> state that untreated endodontic or periapical lesions, or those that have already undergone root canal treatment, in conjunction with unilateral opacification of the maxillary sinus, are characteristic signs of odontogenic sinusitis. Moreover, odontogenic sinusitis is less painful compared to acute sinusitis of nasal origin because there is usually no obstruction of the ostiomeatal complex.

Among the radiographic diagnostic methods are periapical and panoramic radiography, computed tomography, and CBCT, the latter two being considered the reference standard in the identification of odontogenic sinusitis. CBCT provides a three-dimensional evaluation of the maxillary bone region and structures around the root apex of posterior teeth, without causing the distortion and overlap seen in periapical and panoramic views. Other exams, such as magnetic resonance imaging, ultrasonography, and endoscopy, may also be indicated.<sup>10</sup>

CBCT is indicated for a thorough inspection of the maxillary sinus and its relationship with the teeth. It is also indicated for evaluation of patients with chronic persistent sinusitis, especially if it is unilateral. This exam should be included to assist in the differential diagnosis of odontogenic sinusitis<sup>12</sup>.

### **Complementary examinations for diagnosis**

Premoli et al.<sup>12</sup> observed that panoramic radiography is used for the evaluation of the teeth and maxillary sinus. Nevertheless, because it is a two-dimensional image, this type of radiography has limitations in the diagnosis of maxillary sinusitis, as the signals obtained in the image are not very specific. CBCT, on the other hand, provides images with high spatial resolution, besides having an expanded field of view, allowing evaluation of the airways and mucosal thickening. In concomitance, Friere et al.<sup>13</sup> states that CBCT is the most used, due to its high quality and ability to evaluate the sinus anatomy, allowing to observe lesions in the sinus mucosa and its extensions, and bone structures.

Lu et al.<sup>14</sup> reported that maxillary sinus involvement in inflammatory or infectious odontogenic processes occurs mainly by a generalized (65.2%) and localized (24.8%) thickening of the sinus mucosa preceded by maxillary sinusitis (6.4%) and mucosal retention cyst (3.6%). Sinus mucosal thickening is defined when the thickness exceeds 1.0 mm.

## **Treatment**

Lima et al.<sup>3</sup> states that for the treatment of odontogenic sinusitis, it is necessary to identify the causative factor and act on the initiating condition of sinusitis, and once resolved, it starts to have a favorable diagnosis and usually easy resolution. The approach may include tooth extractions, endodontic retreatment, foreign body removal, and periodontal treatment. The treatment may be associated with antibiotic therapy and is based on multidisciplinary, with the monitoring of several health professionals.

Patil et al.<sup>4</sup> reiterate almost in full the study of Lima et al.<sup>3</sup>, that the prevalence of non-surgical endodontic therapies, implants, and periradicular surgeries, agreeing with the topic that if the causative factor is not addressed, the treatment of odontogenic sinusitis will be being performed incorrectly, tending to errors of execution, high rates of recurrence and inflammation.

Lopes et al.,<sup>15</sup> adds as the surgeries for odontogenic maxillary sinusitis have advanced, as they were quite aggressive and consisted of the complete removal of the sinus membrane, with improvement in techniques, the surgical treatment was directed to the obstruction, as it was found that the changes in the sinus membrane were a consequence of the inflammatory process. Lopes et al.<sup>15</sup> highlights that with the use of antibiotic therapy, some cases of odontogenic sinusitis do not need a surgical approach, and cases in which oroantral fistulas had a diameter smaller than 5 cm were also observed spontaneous closure with the pharmacological treatment.

According to Lopes et al.<sup>15</sup> and Lima et al.<sup>3</sup> the most commonly used surgical treatment for the condition is done through the Caldwell-Luc technique, in which an osteotomy is performed to gain access to the maxillary sinus. Through this opening, it is possible to access the sinus and drain the mucosa. Furthermore, nasal endoscopic surgery in the sinus affected by sinusitis is necessary for patients who do not show improvement with pharmacological treatment.

## **CONCLUSION**

The anatomical location of the maxillary sinus allows the roots of the premolar and molar teeth to be very close to the sinus, so inflammation in the dental element allows the inflammatory process to expand into the maxillary sinus, giving rise to OMS.

Apical periodontitis is the most frequent non-iatrogenic cause with 25.1% of the cases. However, clinically, odontogenic sinusitis has very similar symptoms to non-odontogenic sinusitis, so it is necessary to perform CBCT, which provides high-resolution images and is effective in the diagnosis of apical periodontitis.

After diagnosis and determination of the etiopathogenesis, it is possible to choose the specific treatment for each case, which can range from periodontal treatment to exodontia of the element in question.



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