REPUBLIQUE DU CAMEROUN
Paix – Travail – Patrie
****
MINISTERE DE L'ENSEIGNEMENT SUPERIEUR
****
UNIVERSITE DE YAOUNDE I
****
FACULTE DE MEDECINE ET DES SCIENCES BIOMEDICALES

REPUBLIC OF CAMEROON
Peace – Work – Fatherland
****
MINISTRY OF HIGHER EDUCATION
****
THE UNIVERSITY OF YAOUNDE I
****
FACULTY OF MEDICINE AND BIOMEDICAL SCIENCES

DEPARTMENT OF OPHTHALMOLOGY, ENT AND STOMATOLOGY

Knowledge, attitudes and practices of dental surgeons in the management of patients with odontogenic maxillary sinusitis in the city of Yaoundé

Thesis presented and defended in partial fulfillment of the requirements for the award of a doctorate degree in Bucco-dental medicine

By

NYINGCHUO BERTRAND NSOM

Registration Number: 16M185

Director:
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Associate Professor
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Academic Year 2022-2023

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Defense Date: 19th June 2023

Jury

President of the jury:

Prof. Odile Fernande ZEH

Professor of Radiology and Medical Imaging

Members:

Prof. Marie José Essi

Professor of Medical Anthropology and Public Health

Dr. Andjock Nkouo Yves Christian

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TABLE OF CONTENT

DEDICATION

I dedicate this work to

My Savior Jesus Christ, the author and owner of my life; through whom I have achieved every feat in life,

&

To my dear late grandmother, Nawain MONICA NAIN Kuoh and the entire family!

ACKNOWLEDGEMENT

This work would not have been a success without the material and intellectual contribution of some persons. They are:

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- Professor NGABA MBALLA ep. MAMBO POUKA OLIVE Nicole who honored me by leading this work. Thank you for your availability, your motherly kindness, your patience, your understanding and your corrections Professor.
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- To my esteemed RHIM FM Global family, thank you for always standing by me.
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- To all my mentors, thank you for your prayers and support all through this process.
- To all the mentees of Papa B's Mentorship Network, thank you for the confidence you have in me. It is one of the reasons why I worked so hard to finish this seven years journey well.
- To all dental surgeons who agreed to participate in this study. Thank you for your collaboration.
- To every other person who could not be named here and who contributed to my intellectual and moral edification. Kindly receive my profound gratitude.

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- HOD = Head of Department
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- AP = Associate Professor
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- L = Lecturer

THE PHYSICIAN'S OATH

Declaration of Geneva, Switzerland, September 1948 and amended by the 22nd World Medical Assembly, Sydney, Australia (August 1968).

I will practice my profession with conscience and dignity;

The health of my patients will be my first consideration;

I will respect secrets confided in me, even after the patient has died;

I will maintain by all the means in my power the honor and noble traditions of the medical profession;

My colleagues will be my brothers and sisters;

I will not permit considerations of religion, nationality, race, political party or social standing to intervene between my duty and my patient;

I will maintain the utmost respect for human life from the time of conception, even under threat

I will not use my medical knowledge contrary to the laws of humanity; I make these promises solemnly, freely and upon my honor.

ABSTRACT

BACKGROUND: Odontogenic maxillary sinusitis, also known as sinusitis of dental origin is a well-known but understudied form of sinusitis that requires a well codified treatment regimen. It is a common disease in dental, otorhinolaryngologic, allergic, general, and maxillofacial contexts. It may have several causes such as infections of antral teeth leading to the violation of the sinus membrane, pathologic lesions of the jaws and teeth, maxillary (dental) trauma, or iatrogenic causes such as complications of dental and implant surgery, endodontic treatment and maxillofacial surgery procedures. From a holistic perspective, the management of odontogenic maxillary sinusitis demands proficuous collaboration between the dentist and an ENT specialist; because odontogenic maxillary sinusitis is a border condition between otolaryngology and dental science.

OBJECTIVE: The objective of this study was to assess the knowledge, attitudes and practices of dental surgeons in the management of patients with odontogenic maxillary sinusitis in the city of Yaoundé.

METHODOLOGY: We conducted a descriptive cross-sectional study in some public and private hospitals, as well as private dental cabinets in the city of Yaoundé. The study was carried out over a period of four months, from January 2023 to April 2023. We carried out a consecutive non-probabilistic sampling of all registered dental surgeons working in the city of Yaoundé. The software used for data entry and analysis were SPSS 23, Excel 2013 with a significance level set at 5 %. The variables evaluated during the study using a pre-established questionnaire were socio-demographic data (age, gender, number of years in service, type of working place, domain of specialization, bucco-dental school attended), knowledge on odontogenic maxillary sinusitis, clinical and paraclinical assessment of odontogenic maxillary sinusitis, education and training in the management of odontogenic maxillary sinusitis, attitudes towards patients with odontogenic maxillary sinusitis, management and preventive practices.

PRINCIPAL RESULTS: Of the 97 respondents, 31 responded through the online Google form (31.96 %), while the rest (68.04 %) responded through the printed questionnaires. Majority of our participants (82.5 %) had not received any special training for the management of OMS and 34.0 % agreed they have an information deficiency on the disease. 33.0 % of our study population said they found it difficult to diagnose OMS in their daily practice and 25.8 % said they do not feel comfortable handling OMS cases. According to most participants, the maxillary second premolar was the tooth with the highest probability of causing OMS (37.1 %), iatrogenic

factors constituted the highest risk factors (96.9 %), nasal congestion was the highest clinical sign (91.8 %) and orbital cellulitis was the most common complication (92.8 %). Of the various treatment options proposed for OMS, most participants chose antibiotherapy (96.9 %) and for combined treatment options, most chose dental treatment and antibiotherapy together (67.3 %). A good number of participants (42.3 %) said they do not see any need to refer a patient to an ENT specialist once they are able to identify and treat the dental source of the sinusitis. 61.9 % knew and used the Valsalva maneuver after the extraction of an antral tooth to determine if there is oroantral communication. Only 10.3 % said they use retroalveolar X-rays before commencing treatment procedures on antral teeth and for follow up. Overall, 54.6 % of the participating dental surgeons had an average knowledge on odontogenic maxillary sinusitis, 4.1 % had a good knowledge, 33.0 % had insufficient knowledge and 13.4 % had a poor knowledge. For attitudes, 33.0 % had attitudes that fall within the average range, 4.1 % had good attitudes, 33.0 % had attitudes that fall within the insufficient range and 29.9 % had poor attitudes. For practices, 40.2 % had practices that fall within the average range, 29.9 % had practices that fall within the insufficient range, 25.8 % had poor practices and 4.1 % had good practices.

CONCLUSION: This study reveals that dental surgeons have limited (average) knowledge as regards the management of odontogenic maxillary sinusitis, resulting in mediocre attitudes and practices. Very few dental surgeons have received special training for OMS management and prevention. This is why iatrogenic factors remain the leading causes of OMS. There is a need for OMS to be given serious attention in the dental curriculum of our medical faculties. Many prospective studies are needed to determine the best approach to caring for this patient population.

KEY TERMS: Odontogenic maxillary sinusitis; maxillary sinus; antral teeth; dental surgeons.

RESUME

Introduction : La sinusite maxillaire odontogène, également connue sous le nom de sinusite d'origine dentaire, est une forme de sinusite bien connue qui nécessite un régime de traitement bien codifié. Il s'agit d'une maladie courante en médicine buccodentaires, chez les oto-rhino-laryngologistes, les spécialistes des allergies et les maxillo-faciaux. Elle peut avoir plusieurs causes, telles que des infections des dents antrales entraînant une violation de la membrane sinusienne, des lésions pathologiques des mâchoires et des dents, des traumatismes maxillaires (dentaires) ou des causes iatrogènes telles que des complications de la chirurgie dentaire et implantaire, du traitement endodontique et des procédures de chirurgie maxillo-faciale. D'un point de vue holistique, la prise en charge de la sinusite maxillaire odontogène exige une collaboration étroite entre le dentiste et le spécialiste ORL, car la sinusite maxillaire odontogène est une affection qui se situe à la frontière entre l'oto-rhino-laryngologie et l'odontologie.

Objectif : L'objectif de cette étude était d'évaluer les connaissances, les attitudes et les pratiques des chirurgiens-dentistes dans la prise en charge des patients atteints de sinusite maxillaire odontogène dans la ville de Yaoundé.

Méthodologie : Nous avons mené une étude transversale descriptive dans certains hôpitaux publics et privés, ainsi que dans des cabinets dentaires privés de la ville de Yaoundé. L'étude s'est déroulée sur une période de quatre mois, de janvier 2023 à avril 2023. Nous avons procédé à un échantillonnage consécutif non probabiliste de tous les chirurgiens-dentistes inscrits à l'ordre national exerçant dans la ville de Yaoundé. Les logiciels utilisés pour la saisie et l'analyse des données sont SPSS 23, Excel 2013 avec un seuil de signification fixé à 5 %. Les variables évaluées au cours de l'étude à l'aide d'un questionnaire préétabli étaient les données sociodémographiques (âge, sexe, nombre d'années de service, type de lieu de travail, domaine de spécialisation, faculté bucco-dentaire), les connaissances sur la sinusite maxillaire odontogène, les connaissances sur la prise en charge dans la pratique quotidienne, l'évaluation clinique et paraclinique, l'éducation et la formation à la prise en charge, les attitudes envers les patients, la gestion et les pratiques préventives.

Résultats : Sur les 97 personnes interrogées, 31 ont répondu via le formulaire Google en ligne (31,96 %), tandis que les autres (68.04 %) ont répondu via les questionnaires imprimés. La majorité de nos participants (82,5 %) n'ont pas reçu de formation spéciale pour la prise en charge de la sinusite maxillaire odontogène et 34,0 % reconnaissent avoir un manque d'information sur la maladie. 33,0 % des participants à notre étude ont déclaré qu'il leur était difficile de

diagnostiquer la sinusite maxillaire odontogène dans leur pratique quotidienne et 25,8 % ont déclaré qu'ils ne se sentaient pas à l'aise pour traiter les cas de la sinusite maxillaire odontogène. Selon la plupart des participants, la deuxième prémolaire maxillaire est la dent qui a la plus forte probabilité de provoquer une sinusite maxillaire odontogène (37,1 %), les facteurs iatrogènes constituent les facteurs de risque les plus élevés (96,9 %), la congestion nasale était le signe clinique le plus fréquent (91,8 %) et la cellulite orbitaire était la complication la plus fréquente (92,8 %). Parmi les différentes options thérapeutiques proposées pour la sinusite maxillaire odontogène, la plupart des participants ont choisi l'antibiothérapie (96,9 %) et pour les options thérapeutiques combinées, la plupart ont choisi le traitement dentaire et l'antibiothérapie ensemble (67,3 %). Un bon nombre de participants (42,3 %) ont déclaré qu'ils ne voyaient pas la nécessité d'adresser un patient à un spécialiste ORL une fois qu'ils étaient en mesure d'identifier et de traiter l'origine dentaire de la sinusite. 61,9 % connaissaient et utilisaient la manœuvre de Valsalva après l'extraction d'une dent antrale pour déterminer s'il y a une communication oro-antrale. Seul 10,3 % ont déclaré utiliser des radiographies rétroalvéolaires avant d'entamer les procédures de traitement des dents antrales et pour le suivi. Globalement, 54,6 % des participants avaient une connaissance moyenne de la sinusite maxillaire odontogène, 4,1 % une bonne connaissance, 33,0 % une connaissance insuffisante et 13,4 % une mauvaise connaissance. En ce qui concerne les attitudes, 33,0 % avaient des attitudes moyenne, 4,1 % avaient des bonnes attitudes, 33,0 % avaient des attitudes insuffisante et 29,9 % avaient des attitudes médiocres. En ce qui concerne les pratiques, 40,2 % avaient des pratiques moyenne, 29,9 % avaient des pratiques insuffisante, 25,8 % avaient des pratiques médiocres et 4,1 % avaient des bonnes pratiques.

Conclusion : Cette étude révèle que les chirurgiens-dentistes ont des connaissances limitées (moyennes) sur la prise en charge de la sinusite maxillaire odontogène, ce qui se traduit par des attitudes et des pratiques médiocres. Très peu de chirurgiens-dentistes ont reçu une formation spéciale pour la gestion et la prévention de la sinusite maxillaire odontogène. C’est pourquoi les facteurs iatrogènes restent les principales causes de la sinusite maxillaire odontogène. Il est nécessaire d'accorder une attention particulière à la sinusite maxillaire odontogène dans les programmes d'études buccodentaires de nos facultés de médecine. De nombreuses études prospectives sont nécessaires pour déterminer la meilleure approche de la prise en charge de cette population de patients.

Mots clés : Sinusite maxillaire odontogène ; sinus maxillaire ; dents antrales ; chirurgiens-dentistes.

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

CBCT: Cone Beam Computed Tomography

CLP: Caldwell Luc Procedure

CT Scan: Computed Tomography Scan

ENT: Ear, Nose and Throat

ESS: Endoscopic Sinus Surgery

FESS: Functional Endoscopic Sinus Surgery

FMBS: Faculty of Medicine and Biomedical Sciences

KAP: Knowledge, Attitudes and Practices

MCC: Mucociliary Clearance

MDCT: Multi-Detector Computed Tomography

MRI: Magnetic Resonance Imaging

MSF: Maxillary Sinus Floor

OAC: OroAntral Communication

OAF: OroAntral Fistula

OMS: Odontogenic Maxillary Sinusitis

OMU: Osteo-Meatal Unit

ONCDC: Ordre National des Chirurgiens-Dentistes du Cameroun

SM: Schneiderian Membrane

SPSS: Statistical Package for the Social Sciences

CHAPTER I: INTRODUCTION

Sinusitis is defined as the inflammation of paranasal sinuses. It can be classified on the basis of the duration of its symptoms and clinical findings into acute and chronic sinusitis [1]. Acute sinusitis is sinonasal inflammation lasting less than 12 weeks and resulting in symptoms such as nasal blockage or congestion, anterior nasal discharge, postnasal drip, daytime cough and facial pain or pressure with or without a decreased sense of smell. Meanwhile, chronic sinusitis has persistent symptoms, including cough, rhinorrhea, or nasal obstruction, lasting more than 12 weeks and can be broadly divided into two phenotypes based on nasal endoscopy and computed tomography findings: chronic sinusitis without nasal polyps and chronic sinusitis with nasal polyps [2]. Sinusitis can also be classified on the basis of its etiology into allergic or non-allergic and odontogenic or non-odontogenic sinusitis [3].

Odontogenic maxillary sinusitis (OMS) is the inflammation of the maxillary sinus as a result of dental pathology, most often resulting from prior dentoalveolar procedures, infections of maxillary dentition, or maxillary dental trauma [4] . It develops when bacteria from a dental infection spreads to the sinus cavity through the roots of a tooth or the bone surrounding the teeth. In other words, OMS occurs when the sinus membrane is violated by conditions such as infections of the maxillary posterior teeth, pathologic lesions of the jaws and teeth, maxillary (dental) trauma, or by iatrogenic causes such as dental and implant surgery complications and maxillofacial surgery procedures. One of the key contributors to this reality is the intimate anatomical relationship between the upper teeth and the maxillary sinus. The bony wall separating the maxillary sinus from teeth roots varies from full absence (when teeth roots are covered only by mucous membrane), to 12mm. This makes any infection on and around antral teeth potential risk factors for odontogenic maxillary sinusitis [5]. According to literature, the incidence of odontogenic sinusitis is 10-12% of all sinusitis cases, but recent studies suggest it may be as high as 41% [6]. In 2020, Nurchis *et al.* conducted a narrative review following the methodology proposed by Green *et al.* (2006) [7]. There appears to have been an increase in the incidence of OMS over the last decade [8]. The iatrogenia was by far the leading cause of odontogenic sinusitis (55.97%) while the first and second molars were the most affected teeth with an incidence of 35.6% and 22% [7]. It is estimated that 10% of cases of chronic maxillary sinusitis are odontogenic in origin, and the percentage is higher in patients with unilateral maxillary disease [8]. Sinusitis is a common condition worldwide, with over 24 million cases in the United States and cause more than 107 million sufferers in China [1]. The prevalence of sinusitis is high amongst Nigerian Africans. My research did not find any readily documented and published statistics on the condition in Cameroon [9]. Furthermore, literature search

revealed that there is lack of consensus globally concerning the management plan for odontogenic maxillary sinusitis and that very little work has been done on this important and relatively common condition [10].

Odontogenic maxillary sinusitis is a well-known but understudied form of sinusitis that requires a unique treatment regimen that differs from non-odontogenic sinusitis [11]. It usually manifests unilaterally and differs in its pathophysiology, microbiology, diagnostics and management from sinusitis of other causes, although clinical symptoms are not conspicuous sometimes. OMS can be easily misdiagnosed and this will lead to the long-term administration of inappropriate medications or unnecessary surgical management, which will fail to resolve the disease (as a result of failure to address the dental pathology) [5]. Hence, from a holistic perspective, since odontogenic maxillary sinusitis is a border condition between otolaryngology and dental science, its management demands proficuous collaboration between the dentist and an ENT specialist [12]. It is on this basis that this research was conducted; to assess the knowledge dental surgeons have on odontogenic maxillary sinusitis, identify their attitudes towards it, their practices in preventing it and their contribution or participation in its treatment.

I.1. JUSTIFICATION

Odontogenic maxillary sinusitis is a well-known but understudied form of sinusitis that requires a unique treatment regimen, because it differs in its pathophysiology, microbiology, diagnostics and management from sinusitis of other causes. It can be easily misdiagnosed and this will lead to the long-term administration of inappropriate medications or unnecessary surgical management, which will fail to resolve the disease (because of failure to address the dental pathology). On the other hand, certain dental practices can equally contribute greatly to the development of odontogenic sinusitis. Therefore, from a holistic perspective, odontogenic maxillary sinusitis is a border condition between otolaryngology and dental science. Hence, its management demands proficuous collaboration between the dentist and an ENT specialist. It is on this basis that this research was conducted; to assess the knowledge dental surgeons have on odontogenic maxillary sinusitis in the city of Yaoundé, their attitudes towards it, their practices in preventing it and their contribution or participation in its treatment. This will help identify the educational needs amongst dental surgeons on the subject, improve the quality of care given to patients and equally foster collaboration between dental practitioners and ENT specialists.

I.2. RESEARCH QUESTION

What is the level of knowledge, the attitudes and practices of dental surgeons in the management of patients with odontogenic maxillary sinusitis?

I.3. RESEARCH HYPOTHESIS

Dental surgeons have limited knowledge and exhibit mediocre attitudes and practices as regards the prevention and management of odontogenic maxillary sinusitis.

I.4. RESEARCH OBJECTIVES

I.4.1 GENERAL OBJECTIVE

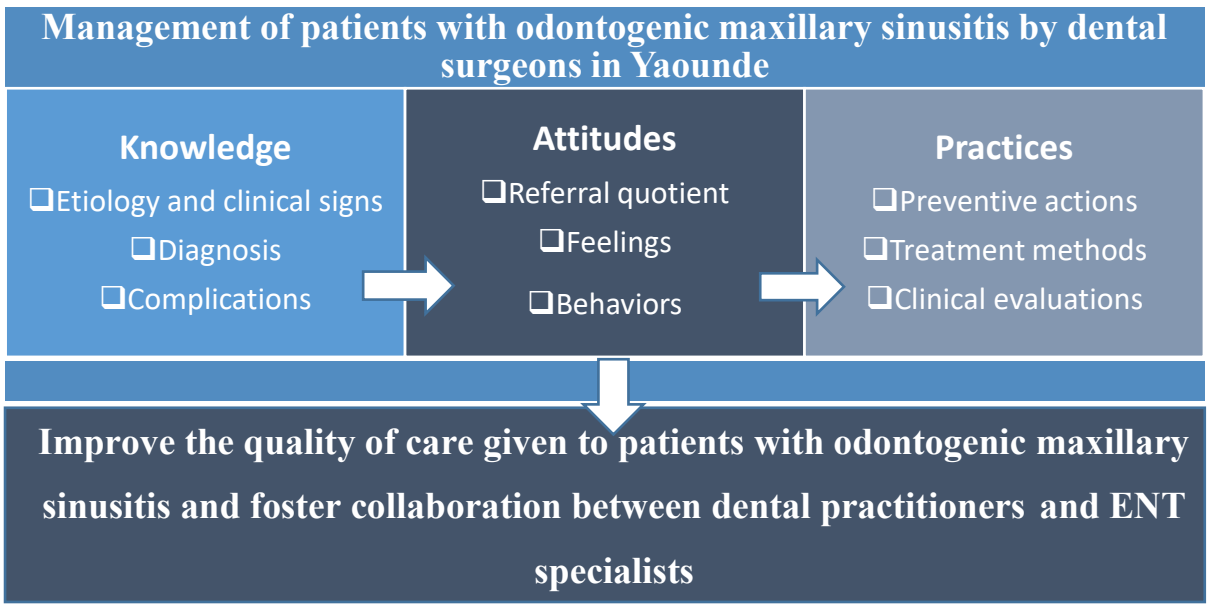
To assess the knowledge, attitudes and practices of dental surgeons in the management of patients with odontogenic maxillary sinusitis in the city of Yaoundé.

I.4.2 SPECIFIC OBJECTIVES

The specific objectives of this research include:

i. Determine the level of knowledge of dental surgeons on odontogenic maxillary sinusitis.
ii. Identify the attitudes of dental surgeons as regards the management of odontogenic maxillary sinusitis.
iii. Describe dental clinical practices that can play a role in the prevention of the disease and the role of dental surgeons in the management plan of the disease.

Conceptual Framework



I.5. OPERATIONAL DEFINITION OF TERMS

- **Odontogenic maxillary sinusitis:** It is a symptomatic inflammation of the maxillary sinus as a result of a dental pathology or dental procedures.
- **Knowledge:** The general notions which dental surgeons have concerning the etiology, clinical signs, diagnosis, complications, treatment methods and prevention of odontogenic maxillary sinusitis.
- **Attitudes:** The conceptions, feelings or behaviors of dental surgeons as far as odontogenic maxillary sinusitis is concerned.
- **Practices:** Actions carried out by dental surgeons to treat or prevent odontogenic maxillary sinusitis.

CHAPTER II: LITERATURE REVIEW

II.1. GENERALITIES

II.1.1. DEFINITION

Sinusitis is defined as the inflammation of paranasal sinuses. It can be classified on the basis of the duration of its symptoms and clinical findings into acute and chronic sinusitis [1]. Acute sinusitis is sinonasal inflammation lasting less than 12 weeks and resulting in symptoms such as nasal blockage or congestion, anterior nasal discharge, postnasal drip, daytime cough and facial pain or pressure with or without a decreased sense of smell. Meanwhile, chronic sinusitis has persistent symptoms, including cough, rhinorrhea, or nasal obstruction, lasting more than 12 weeks and can be broadly divided into two phenotypes based on nasal endoscopy and computed tomography findings: chronic sinusitis without nasal polyps and chronic sinusitis with nasal polyps [2]. Sinusitis can also be classified on the basis of its etiology into allergic or non-allergic and odontogenic or non-odontogenic sinusitis [3].

Odontogenic maxillary sinusitis is the inflammation of the maxillary sinus as a result of dental pathology, most often resulting from prior dentoalveolar procedures, infections of maxillary dentition, or maxillary dental trauma [4]. It develops when bacteria from a dental infection spreads to the sinus cavity through the roots of a tooth or the bone surrounding the teeth. In other words, OMS occurs when the sinus membrane is violated by conditions such as infections of the maxillary posterior teeth, pathologic lesions of the jaws and teeth, maxillary (dental) trauma, or by iatrogenic causes such as dental and implant surgery complications and maxillofacial surgery procedures. That is, any diseases arising from dental or dentoalveolar structures could affect the Schneiderian membrane, leading to diverse pathologic disease presentations in the maxillary sinus [10]. One of the key contributors to this reality is the intimate anatomical relationship between the upper teeth and the maxillary sinus. The bony wall separating the maxillary sinus from teeth roots varies from full absence (when teeth roots are covered only by mucous membrane), to 12mm. This makes any infection on and around antral teeth potential risk factors for odontogenic maxillary sinusitis [5]. OMS is a common disease in dental, otorhinolaryngologic, allergic, general, and maxillofacial contexts. Figure one shows the diagram of paranasal sinuses.

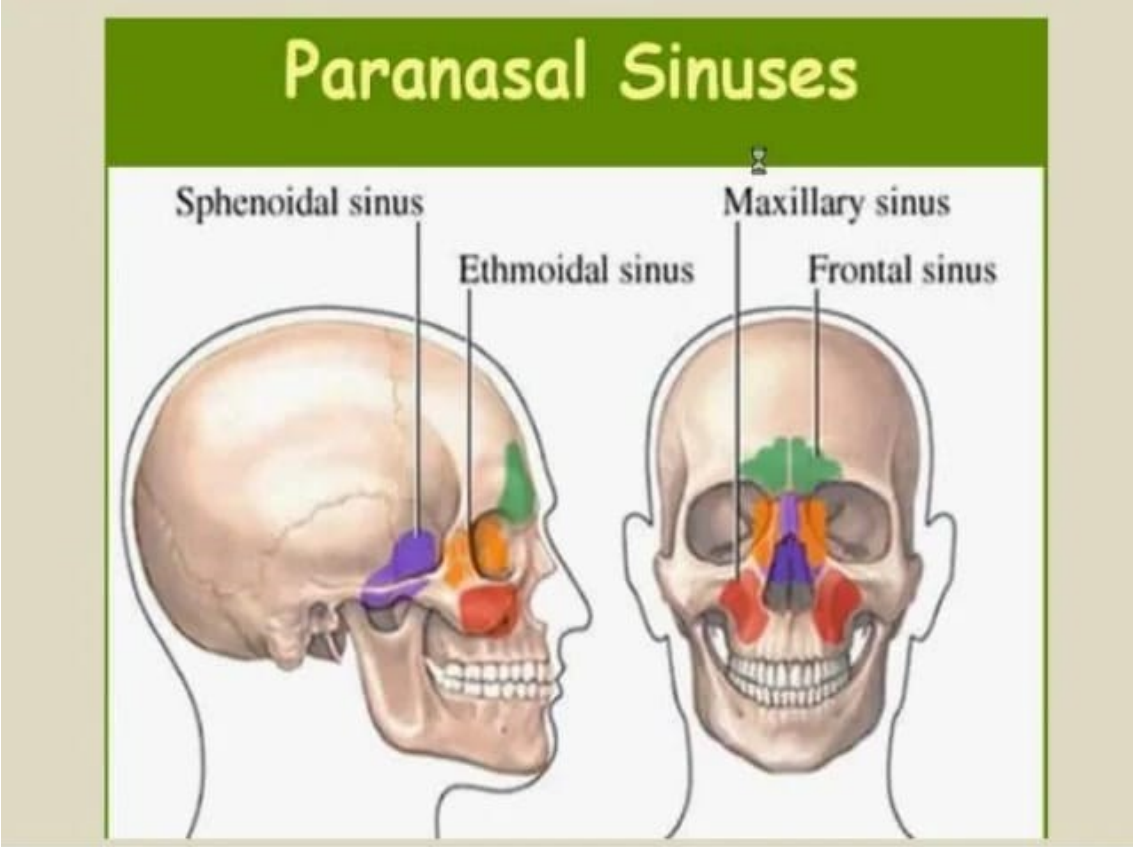


Figure 1: paranasal sinuses[13]**.**

II.1.2. EPIDEMIOLOGY

Sinusitis is a common condition worldwide, with over 24 million cases in the United States and cause more than 107 million sufferers in China[1]. The prevalence of sinusitis is high amongst Nigerian Africans. Our research did not find any readily documented and published statistics on the condition in Cameroon [9]. According to literature, the incidence of odontogenic sinusitis is 10-12% of all sinusitis cases, but recent studies suggest it may be as high as 40% [6]. In 2020, Nurchis et al. conducted a narrative review following the methodology proposed by Green *et al.* (2006) [7]. There appears to have been an increase in the incidence of OMS over the last decade(8). The iatrogenia was by far the leading cause of odontogenic sinusitis (55.97%) while the first and second molars were the most affected teeth with an incidence of 35.6% and 22% [7]. It is estimated that 10% of cases of chronic maxillary sinusitis are odontogenic in origin, and the percentage is higher in patients with unilateral maxillary disease [8].

Odontogenic sinusitis is most common among 40–60 year olds with a slight female predominance. Approximately 50% of patients will report previous dental surgery or infection, however only one-third will report associated dental pain. According to a study by Kaneko, younger individuals (third and fourth decade) appear to be more susceptible to the disease, with

the incidence being highest in the fourth decade [14]. As mentioned above, there has been a sharp rise in the number of cases in recent times (the latest incidence is reported to be as high as 25–40%). According to a study carried out by Raj *et al.* in 2022, this drastic increase in the reported incidence is attributed to two main factors:

i. A neglect in the oral health among those who are unable to afford dental treatment, and
ii. An increase in the number of people retaining their teeth with the current practice of conservative dentistry and more complex reconstructive dental procedures being performed [15].

II.2. ANATOMY OF THE MAXILLARY SINUS AND ANTRAL TEETH

II.2.1 Generalities

There are four pairs of paranasal sinuses: the maxillary, ethmoidal, frontal and sphenoidal sinuses. They are air-filled, mucosa-lined spaces within the maxillofacial region and skull, centered on and communicating with the nasal cavity. They serve to improve the respiratory function of the nose, give resonance to voice, contribute to the shape of the face and provide some degree of warmth and humidification to inspired air [16]. They also play a role in the protection of the orbit and the brain in case of skull fractures, as well as weight reduction of the skull. The nose and paranasal sinuses form a functional unit and they are an integral part of the respiratory tract with the tracheobronchial tree and lungs. The paranasal sinuses are also involved in the production of nitrogen monoxide and thus in supporting the immune defense of the nasal cavity [17].

II.2.2 History, location and development of the maxillary sinus

The maxillary sinuses were first illustrated and described by Leonardo da Vinci in 1489, and later documented by the English anatomist, Nathaniel Highmore in 1651. The maxillary sinus, or antrum of Highmore, which lies within the body of the maxillary bone is the first of the paranasal sinuses to develop in human foetal life and the largest. Its development commences at 17 weeks in utero. At birth, it is a rudimentary aerated or fluid-filled slit orientated longest in the anteroposterior dimension with a volume of 60–80 mm3, situated inferomedially to the orbit. Partial or complete opacification of the maxillary sinus in the first few years of life is normal [13]. The maxillary sinus reaches its full development with the eruption of permanent teeth between 12 and 14 years of age, containing an average volume of 15-20mL [11].

Growth of the maxillary sinus is proportional to growth of the facial bones. Both occur in phases with the first phase occurring during the first 3 years of life: the sinus extending

laterally to the infraorbital canal by the end of this phase. The second phase of growth occurs during years 6–12 with lateral extension to the zygomatic recess of the maxilla and inferior extension to the level of the hard palate by 9 years. Subsequent sinus expansion during the third phase comes from pneumatization of the maxillary alveolus, as the permanent molar and premolar teeth erupt displacing the floor of the sinus 4–5 mm below the floor of the nasal cavity. Its growth ends with the eruption of the third molars at approximately 20 years of age [18]. The most rapid increase in size of the maxillary sinus occurs from 0 to 4 years with a gradual increase in size from 4 to 8 years [13].

Figure 2 shows the development of the maxillary sinuses. Up to the age of 12 years, growth of the maxillary sinus is predominantly in a lateral direction towards the zygoma creating the zygomatic recess (white arrow in b) and inferiorly to the level of the hard palate. Thereafter, the sinus expands inferiorly below the level of the nasal floor (white arrows in c, d) [13].

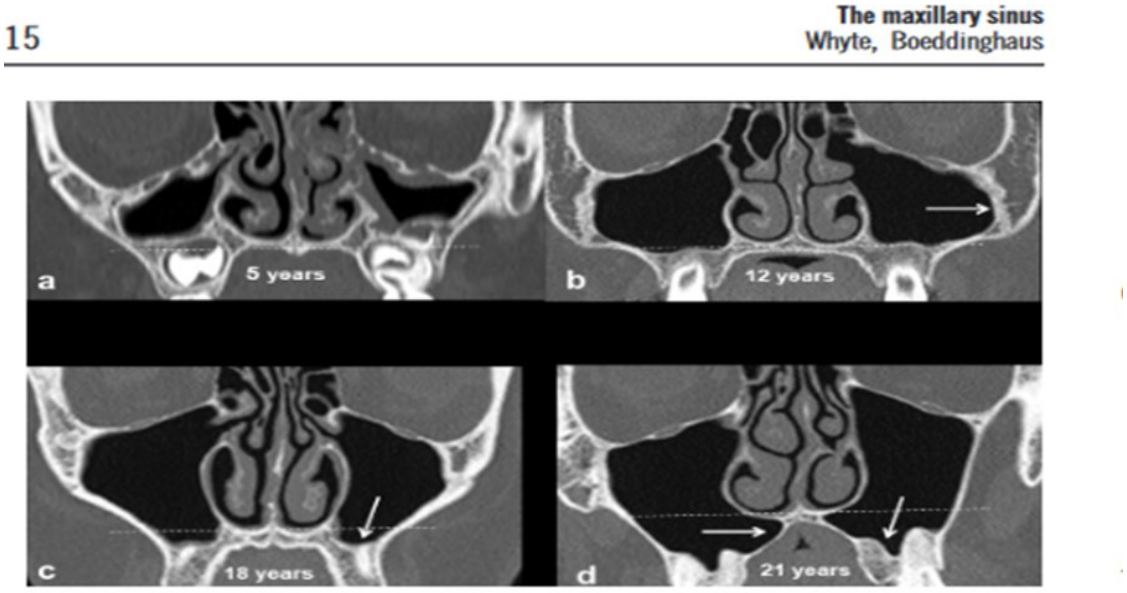


Figure 2: development of the maxillary sinuses [13].

Figure 3 shows the maxillary sinus septa and ridges. Septa arising from the inferior wall of the maxillary sinuses are shown on a cropped dental panoramic tomogram (white arrows in a), oblique sagittal (white arrow in b) and cropped panoramic reconstructions from CBCT (white arrow in c). A thicker and shorter inferior sinus ridge overlies the 17 region in b (dashed white arrow) and the alveolar recess of the right maxillary sinus extends towards the ridge crest in the edentulous 16 region (dotted white arrow). CBCT: cone beam CT [13].

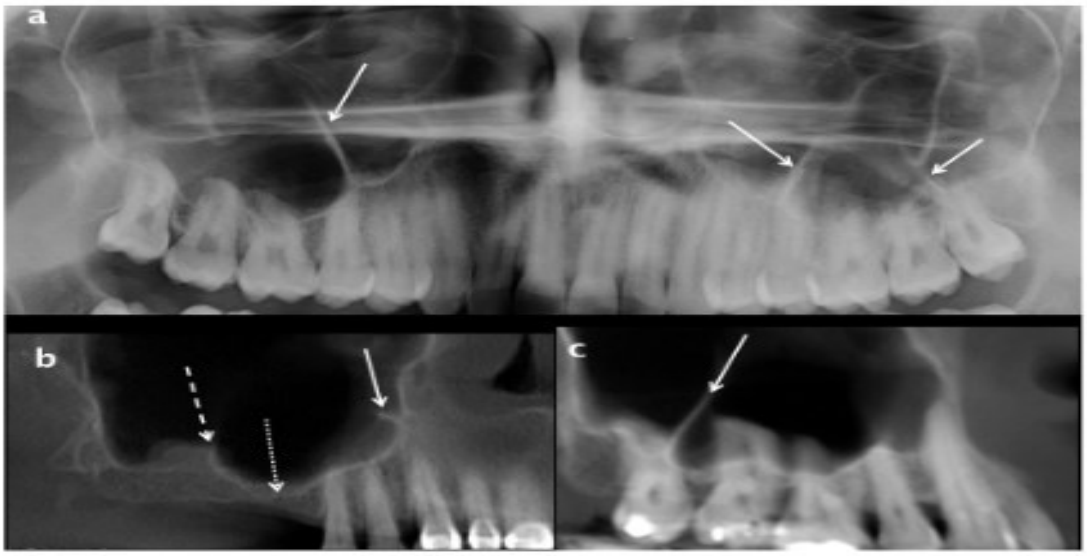


Figure 3: maxillary sinus septa and ridges [13].

II.2.3 Structure

The maxillary sinus is a hollow space lined by a membrane, and communicates with the nasal fossa. It has the shape of a triangular pyramid, with an internal base adjacent to the nasal cavity and an external blunt apex pointing towards the zygoma, and is in relation with the maxillary molars and premolars. The sinus membrane lining is composed of ciliary mucosa that expels mucosal secretions towards the antral orifice [19]. It has several sinus recesses: the alveolar recess pointing inferiorly, the zygomatic recess pointing laterally, a variable palatine recess (an extension of the alveolar recess) between the floor of the nasal cavity and the roof of the oral cavity and the infraorbital recess pointing superiorly bounded by the orbital surface of the maxilla. There are six maxillary sinus walls: the superior, anterior, lateral and medial walls are broad, with narrow posterior and inferior walls [13].

The roots of the maxillary second molars are in closest proximity to the sinus floor, followed in frequency by the roots of the first molar, third molar, second premolar, and first premolar. The floors of the maxillary sinus are consisted of thick cortical bone, not allowing a direct penetration of odontogenic infections into the maxilla bone. However, the alveolar bone of the maxilla can become thinner with increasing age, leaving a layer of mucoperiosteum with respiratory epithelium between the maxillary sinus and the oral cavity, referred to as the Schneiderian membrane. This will predispose the sinus to more direct penetration of odontogenic infections. Also, when the pneumatization of the sinus continues even after the eruption of the permanent teeth, the third molar, premolars and canine teeth may protrude into

the sinus; because the alveolar process of the maxilla which supports the dentition, forms the inferior boundary of the sinus [11].

II.2.4 Vascularization and innervation

Two arteries fundamentally provide for the vascularization of the maxillary sinus: the sphenopalatine artery and the superior alveolar artery. There is equally contribution from the facial artery, the anterior ethmoidal artery and the suborbital artery. Sensory innervation originates from the posterior dental nerve and the infraorbital nerve with its corresponding branches: mid-dental, anterior dental and small direct branches of the sinus mucosa. These fibers distribute in plexus form above the apexes to innervate both the dental roots and the maxillary sinus proper [19].

N/B: It is important to note that infection can extend to the maxillary sinus, not only because of the topographic closeness between the roots and the sinusal floor, but also by means of circulation due to the common vascularization between the sinusal mucosa and periodontal tissue and/or through the fascial spaces [20].

II.2.5 Relationship between the maxillary sinus and antral teeth

The root apices of posterior maxillary teeth have close anatomical proximity to the maxillary sinus floor. Sometimes, the roots of maxillary premolar, molar and occasionally canine teeth even project into the maxillary sinus. It is because of this proximity that teeth infections can easily spread into the maxillary sinus through periapical tissues and cause odontogenic maxillary sinusitis. The periapical and marginal lesion of these roots close to or extending into the MSF could (apart from causing inflammatory changes in the mucosal lining of the sinus) intrude into the sinus via bone marrow, blood vessels and lymphatics. Mehra and Murad reported that when there is a close proximity of root apices of teeth with necrotic pulp and the MSF, the maxillary sinus can also be influenced. If clinical operation errors occur during root canal treatment, the root canal shaping instruments, flushing fluid and filling materials can extrude to the maxillary sinus subsequently. In addition, a perforation of the MSF can occur and result in oroantral fistula during tooth extraction. The maxillary sinus can also experience a pathological change because of improper implant therapy. All these reasons can result in various complications, such as odontogenic maxillary sinusitis (which is the focus of our research), endo-antral syndrome and even traumatic alterations, which are complex problems for dentists and otolaryngologists [21]. This is why it is essential for clinicians to be aware of the exact relationship between the apical roots of these maxillary teeth and the maxillary sinus floor.

Eberhardt *et al.* found the mean distance between the maxillary posterior teeth and the maxillary sinus floor to be 1.97 mm(18). According to a study carried out in China by Gu *et al.* in 2018, race, gender, age, side and presence or absence of adjacent teeth may influence the mean distances between the root apices and the MSF. The study also found out that the roots of maxillary first premolars have little relationship with the MSF whereas the roots of the maxillary second premolars have a relatively more close relationship to the MSF. There were no significant differences between the left and right premolars. For maxillary molars, the palatal roots of the maxillary first molars had a more intimate relationship (24.8%) with the MSF, followed by the mesiobuccal roots of the maxillary second molars (21.6%). This indicates that dentists should pay more attention to these two roots during dental treatment, because the perforation of MSF in the area is more likely to occur [21].

Figure 4 shows the relationship of the apices of the posterior maxillary teeth to the maxillary sinus.

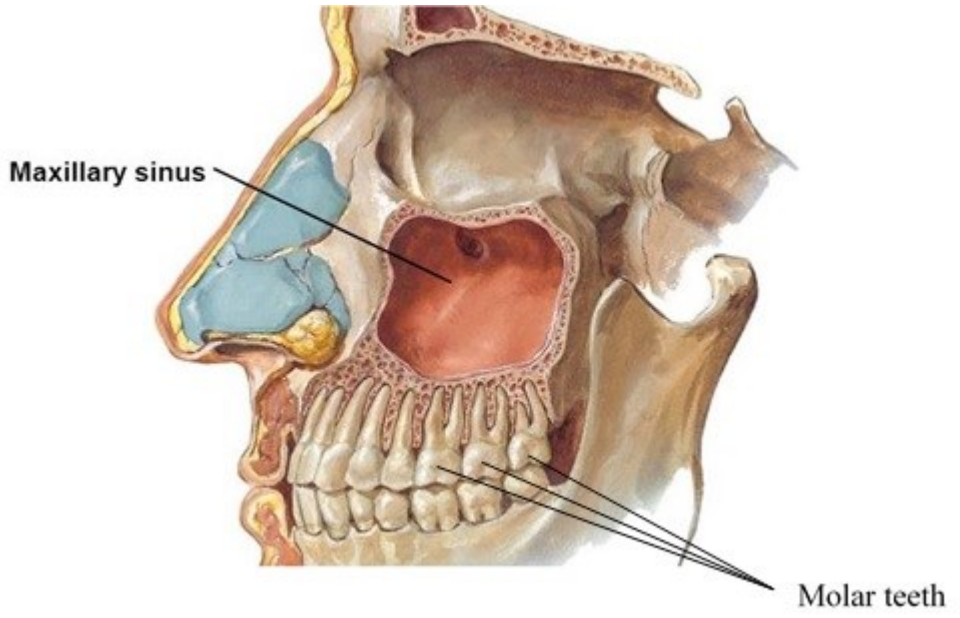


Figure 4: relationship between posterior maxillary teeth and the maxillary sinus [13].

II.3. PHYSIOPATHOLOGY

II.3.1 Normal physiology

The nose and sinuses are lined by a pseudostratified columnar ciliated epithelium with numerous goblet cells supported by a vascular lamina propria containing serous and mucous glands and numerous thin-walled venules. This epithelium, known as Schneiderian membrane, which lines the inner respiratory mucosa of the maxillary sinuses plays an essential role in

mucociliary clearance and keeping the upper airway clean by driving continuous ciliary beating to move inhaled foreign bodies, bacteria, fungi, and viruses toward the oropharyngeal airway. It produces mucus that moves to the ostium for drainage into the nasal cavity against normal gravity, with movement of cilia around the maxillary sinus occurring in a synchronized pattern. This mucus, passing from the nasal cavity to the nasopharynx, is swallowed and passes into the esophagus and stomach. Any interruption of these basic movements of mucus by reduced ciliary activity or obstruction of ostia can result in sinus disease and symptoms. These basic protective functions are aided by the airway epithelium with mucin secretions that create ion or fluid transport to maintain mucous viscosity. Several chemokines are secreted according to pathogen exposure levels to activate inflammatory or protective immune pathways by recruitment of macrophages, dendritic cells, eosinophils, neutrophils, T cells, and NK cells. Several cytokines, including IL-1β, IL-6, TNFα, IL-8, and monocyte chemotactic protein 1, are also released. These epithelial cells of SM are connected by tight junctions to form a physical defensive wall, and mucociliary transport is managed by the formation of reactive oxygen and nitrogen species through control of antimicrobial peptides such as lactotransferrin, lysozyme, and defensins [3]. Mucociliary clearance is a primary defence mechanism of the respiratory tract to protect against inhaled pollutants, allergens and pathogens. The functional components of the mucociliary apparatus include the cilia and a protective mucous layer which is secreted by goblet cells in the epithelium and mucous glands in the lamina propria. Mucus acts like flypaper, trapping airborne particles inspired through the nose. The mucus is in two layers; a thin and watery sol layer which bathes the cilia allowing them to move easily and the superficial, thick and sticky gel layer responsible for trapping the inspired particles. Cilia act in a co-ordinated fashion to move the gel layer and trapped particles (at a rate of about 6 mm per minute) towards the sinus ostium and from there to the nose and posteriorly to the nasopharynx before being swallowed. The health of the nose and paranasal sinuses is primarily dependent on effective mucociliary clearance [13].

The mucociliary pathway always leads towards the ostiomeatal unit or complex. The OMU is a common channel that links the frontal sinus, ethmoidal sinus and the maxillary sinus to the middle meatus, allowing ventilation (airflow) and mucociliary drainage. It is located superiorly on the medial wall and has an average diameter of 2.4mm, while the bony window is much larger. The effective opening of the ostium may be reduced by the projection of the uncinate process, which is an extension of the inferior turbinate and the surrounding soft tissues[3]. Inflammation or blockage of the OMU will induce sinusitis, including cases involving several sinuses, referred to as pan-sinusitis. The combination of a large surface area

provided by the nasal cavity and convolutions of the turbinates, the secreted mucus and a profuse blood supply in the lamina propria allows the nose to heat and humidify inspired air. The nose can turn dry, cold air into moist, warm air in under a second and this process of air conditioning is essential for the function and health of the lower respiratory tract (larynx, trachea, bronchi, bronchioles and alveoli) [13].

The maxillary sinuses, to some extent, participate in all the functions of the nose except that of olfaction. The resonance of the speaking and singing voice is greatly influenced by the state of the nasal cavities and the accessory sinuses and the most important of these latter are the maxillary sinuses. The antra are likewise concerned in the process of preparing inspired air for reception into the lower respiratory tract, which entails cleansing, warming and humidification. These processes, which are basically physical, depend on four important factors:

i. Air currents,
ii. Capillary blood flow,
iii. Cilia,
iv. Mucus.

The separate functions of each of these are well known. The normal physiology of the maxillary sinuses depends on the integrity and activity of the microscopic cilia together with the healthy overlying mucous blanket [22].

II.3.2 Etiopathology

When odontogenic infections such as periapical lesion is constantly presented at the floor of the maxillary sinus, the maxillary sinus is exposed to the potential danger of inflammation. Bauer reported that inflammation and infection from tooth roots could spread through the maxillary alveolar bone and sinus mucosa, thereby causing sinus inflammation and infection. Inflammation chains between dental lesions, odontogenic infection and retardation factors of sinusitis influence odontogenic maxillary sinusitis. A vicious cycle of inflammation in the closed maxillary sinus results in intractable maxillary sinusitis [23]. The origin of odontogenic maxillary sinusitis is the pathogenic teeth; from the teeth, it diffuses to the maxillary sinus floor, then from the maxillary sinus floor, it spreads to the maxillary sinus ostium and finally to the tissues around the maxillary sinus ostium and other accessory sinuses. The microorganisms can even scatter over to the orbit and brain [24].

Throughout life, the relationship between the dental-periodontal units and the maxillary sinuses are in a continuous dynamic position, determined by the physiological or

pathological changes to which the facial massif is subjected. Individual factors related to the anatomy of the sinus floor may be added to these factors: absent floor with dental roots in the sinus cavity, or with the apex covered only by the sinus mucoperiosteum. Another situation commonly encountered in partially or wholly edentulous persons is the pneumatisation of the sinus cavity, which can progress inferiorly, forming a recession towards the alveolar bone, the result being the existence of only a thin layer of alveolar bone between the sinus and the oral cavity. The following are possible causes of OMS:

- infectious causes—dental and periodontal pathology: dental caries, endodontic infection caused by deep carious processes that develops with pulp and periapical complications and sometimes through complex endoparodontal lesions with an infrabony periodontal pocket as a starting point;
- iatrogenic causes—the most common cause of OMS by most studies: incorrectly performed sinus lift procedures, dental implants with dimensions and insertion axis not adapted to the individual clinical features, dental ankyloses, oroantral fistulas (a complication of tooth extraction), foreign bodies (perforations during endodontic treatments, overfilling of root canals beyond the apex with filling materials such as zinc-oxide eugenol or gutta percha), dental extractions with or without pushing a fragment of the root into the sinus cavity;
- odontogenic cysts with sinus involvement;
- traumatic injuries of the maxillary bone;

Amongst these many dental etiologies responsible for OMS, majority of studies show that the most common is oroantral fistulas (an epithelialized, pathological, unnatural osteomucosal communication between the oral cavity and the maxillary sinus) [25]. The study done by Sato et al. in 2021 brought more evidence that supports the fact that odontogenic pathologies like pulpitis, periapical lesions, periodontitis, oroantral fistulas or foreign bodies in the sinus related to dental treatment are truly risk factors for OMS [23]. Grygorov *et al.* equally did a study on the causes of OMS, which like many other studies, revealed that iatrogenic impact prevails over other causes. The impact of endodontic treatment and implantation surgery was ranked very high in present time, due to increasing incidence of perforation and damage of the sinus by filling materials, bone or tooth particles, and implants [26]. Figure 5 below shows a Cone-beam CT scan (multiplanar reconstruction, coronal section); the right second molar has undergone endodontics. The cone-beam CT scan shows periapical lesion following insufficient root canal treatment, which results in maxillary sinusitis on the same side [23].

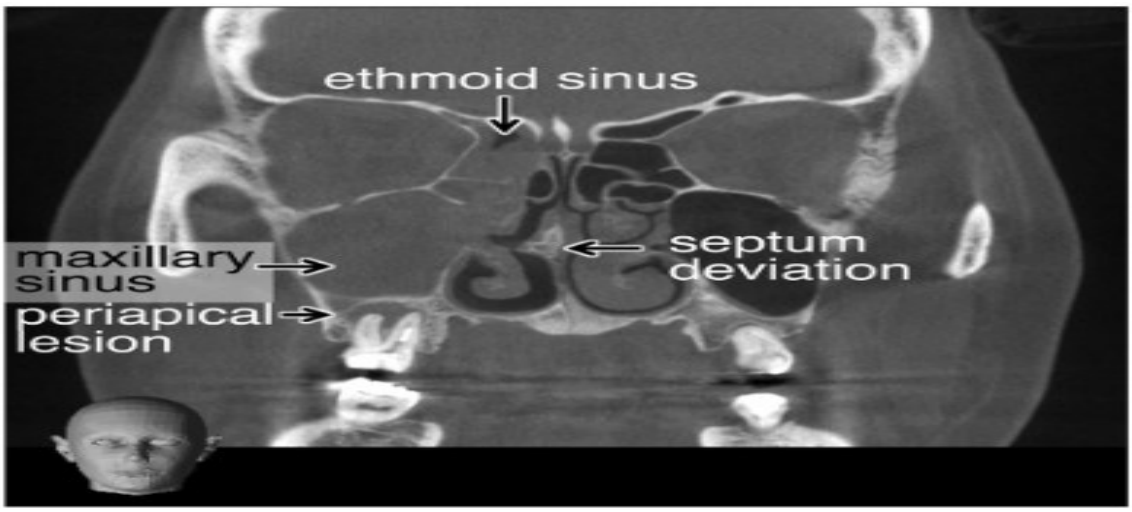


Figure 5: cone-beam CT scan (multiplanar reconstruction, coronal section), showing the right second molar has undergone endodontics [13].

The figure below is a summary of the main etiologic factors involved in the pathogenesis of OMS according to various studies.

Table 1 Main etiologic factors involved in the pathogenesis of odontogenic maxillary sinusitis (OMS).

Author	Nb (patients)	Age (y) median/range	Etiology
Mattos et al.[12]	43	53	Prior dental procedures, OAF
Lee & Lee[13]	27	42.9	Dental implant & dental extraction complications, dentigerous & radicular cysts, dental caries
Felisati et al.[14]	257	51.5	Dental implant dislocation, OMS after sinus lift
Andric et al.[15]	14	NR	OAF after tooth extraction
Chemli et al.[16]	22	39	Periapical infection, foreign bodies, cysts, OAC
Fadda et al.[17]	31	51.3	Dental-related bacterial or fungal OMS, OAF after sinus lift, dental implant dislocation
Hoskison et al.[7]	26	46.2	Periapical infection, OAF, foreign bodies
Lechien et al.[10]	674	45.6	Iatrogenic, apical periodontitis, apical granuloma, odontoma, dental implant, foreign bodies
Lopatin et al.[18]	70	16–62	OAF, foreign bodies
Costa et al.[19]	17	NR	OAF, odontogenic cysts, periimplantitis, foreign bodies
Longhini & Ferguson[20]	21	53	Prior dental procedures
Selmani & Ashammakhi[21]	15	45	Foreign bodies
Jiam et al.[22]	9	63	OMS after sinus lift
Kim et al.[23]	19	54.5	Dental implant-related OMS
Chen et al.[24]	18	53.1	Dental implant-related OMS

OAF: oroantral fistula, OAC: oroantral communication, OMS: odontogenic maxillary sinusitis, NR: not reported.
Foreign bodies: roots, tooth, broken instruments, dental amalgam, dental caries.

Figure 6: table showing main etiologic factors involved in the pathogenesis of OMS according to different studies [19].

II.3.3 Microbiology

The bacteriology of odontogenic sinusitis is different from that of non-odontogenic sinusitis. The range of microbial species found in OMS (acute or chronic) differs from that found in maxillary sinusitis of rhinogenic origin: Streptococcus pneumoniae, Haemophilus influenzae and Moraxella catarrhalis. These are predominant bacteria in acute rhinogenic maxillary sinusitis but are almost always absent in OMS. The microbial flora from OMS is polymorphic, in which anaerobic germs predominate. The flora of acute OMS is represented by aerobes such as Hemolytic Streptococcus alpha, microaerophilic streptococci, Staphylococcus aureus, and Streptococcus pyogenes, but also by anaerobes such as Gram negative bacilli, Peptostreptococcus, Fusobacterium sporulatum, and Propionibacterium acnes. Although literature indicates no certain flora for chronic cases, it is proven that anaerobic flora make the majority [25]. In 2015, Gomes et al. showed that Aspergillius (a filamentous fungus) causes endodontic infections and can cause maxillary sinusitis of dental origin [27]. Various studies regarding the bacterial species involved in OMS report the presence of more than 158 species and several fungi species [25]. The figure below shows the movement of bacteria from a dental infection to the maxillary sinus.

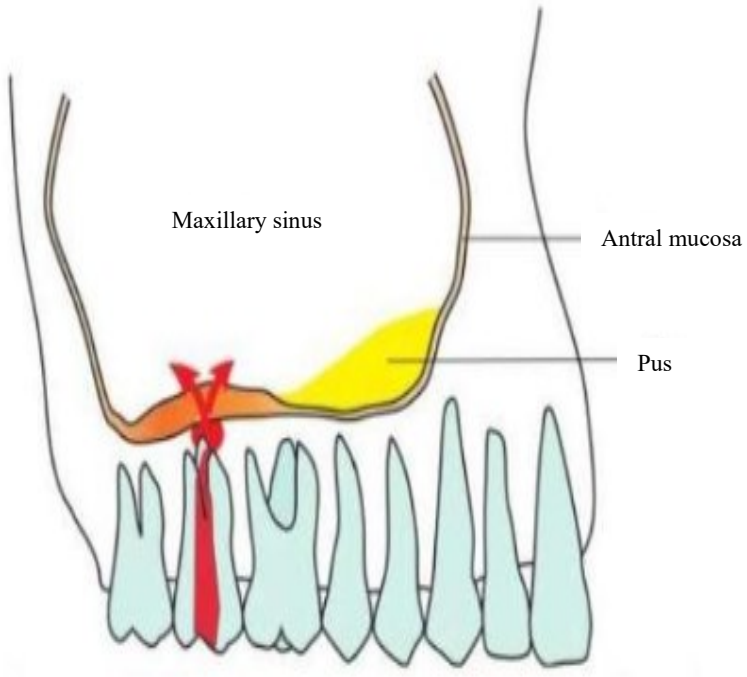


Figure 7: multiplication of bacteria invading from the focus of a dental infection results in OMS [25].

II.4. DIAGNOSIS

II.4.1 Clinical manifestations

As previously mentioned, odontogenic sinusitis develops through the violation of the Schneiderian membrane. In order to be able to make the differential diagnosis, a complex clinical examination is required, starting with taking a careful history (the onset can be difficult for the patient to place), followed by an inventory of symptoms and a general clinical examination.

Unilateral nasal obstruction syndrome is usually the first symptom, accompanied by purulent rhinorrhoea, postnasal drip (purulent secretions visible on the posterior wall of the pharynx), facial pressure (particularly around the nose, eyes, and forehead), dental pain, fatigue, hyposmia, foul smell, bad breath and fever (sometimes) [25]. This clinical table is often incomplete, as sometimes the condition evolves asymptomatically. From the aforementioned symptoms, the most frequent is purulent rhinorrhea, which occurs in 66.7% of cases [30]. Dental pain is often absent and if present in the absence of other symptoms, it is not specific for OMS [31]. These symptoms greatly decrease the quality of the patient's life. It is important to note that none of the above-mentioned symptoms are specific for OMS and therefore, cannot be used as predictive factors for identifying odontogenic causes. Patients may not present with any sinonasal symptoms particularly if the osteomeatal complex is unobstructed, which allows venting of pressure from the infected tooth [15]. In children, the most common indicator of OMS is a history of upper respiratory tract infection, low-grade fever and irritability, purulent nasal discharge and cough of more than 10 days duration [32].

II.4.2 Diagnostic methods

i. Clinical diagnosis

As earlier mentioned, late diagnosis and treatment of OMS can lead to severe complications. Hence, accurate detection and immediate treatment of odontogenic maxillary sinusitis is an important issue in dentistry [33]. The diagnosis of OMS should be based on a thorough dental and medical examination, including evaluation of patient's symptoms and past medical history. Patients with history of extractions of the maxillary molars or an endodontic therapy may likely have OMS. Clinical examination includes inspection of the buccal mucosa and vestibule for swelling, inflammation or erythema. In addition, the pulp is tested by using electric or thermal pulp vitality testing, percussion, and palpation in order to determine if the tooth is hale. If there are teeth with existing root canal therapy, the dentist should examine for any untreated or sub-optimally filled root canals, inappropriate core restorations or leaking

coronal restorations. Both OAC and OAF can also be diagnosed clinically, with the Valsalva test or by examining the extraction region with a blunt probe. To perform the Valsalva test, the patient is instructed to close their mouth, pinch their nose shut and press air out like they are blowing up a balloon; the passage of air or blood at the postoperative site usually indicates the presence of OAC/OAF. The presence of OAF also appears as an altering of the voice due to air leaking from the nose or raising fluid from the mouth to the nose. Additionally, in many cases a small amount of purulent discharge may drip through the OAF. Palpation of the anterior wall of the maxillary sinus may also be painful; percussion of the maxillary posterior teeth with possible sinus involvement may provide clues for localizing the lesion and the causative dental unit. Examination of the oral cavity continues with evaluation of teeth, the coronary integrity, the appearance of dental pulp, the periodontal tissue, the dental roots condition (evaluate the possibility of fractures at this level), the existence of dental implants and possible interventions of sinus lifting [34].

ii. Paraclinical methods

Radiographic imaging is an essential tool in the diagnosis of OMS. 2D radiographs like the orthopantomogram are usually used in the diagnosis of OMS, but it is often difficult because of many structures superimposing in the sinus area. As a result, CT scan, which is a 3D radiograph, is the gold standard in the diagnosis of maxillary sinus disease due to its high resolution and ability to discern bone and soft tissues. Nevertheless, a panoramic radiograph is useful for evaluating the relationship of the maxillary dentition to the sinus, pneumatization, pseudocysts, identifying displaced roots, teeth, or foreign bodies in the sinus [5]. Cone-beam computed tomography (CBCT) is a relatively new tool that has equally become increasingly important in the diagnosis of sinus disease; it uses approximately 10% of the radiation dose of conventional CT but has a higher resolution compared to conventional thin-slice CT [35]. It is worth mentioning that the correct diagnosis does not depend only on the radiographic method, but rather more on the skill of the evaluator. The most accurate method is the CT and CBCT exam. However, sensitivity and specificity vary between 47–89% and 64.3–94.4% respectively, depending on the evaluator [36].

Note: One challenge with diagnosing odontogenic sinusitis is that patients often require evaluations by both otolaryngologists and dental providers. If patients present initially to otolaryngologists, patients' clinical presentations can mimic non-odontogenic rhinosinusitis, and odontogenic sources may not be suspected. Similarly, if patients present first to dental providers with maxillary dental pathology, sinusitis can be overlooked. Another diagnostic hurdle is that optimal dental testing and imaging to confirm

specific dental pathologies causing odontogenic sinusitis may not always be performed, which could lead to false negative dental evaluations [37].

This is why in a research carried out by *Craig et al.* in 2021, a strong consensus was reached; that multidisciplinary evaluations by both otolaryngologists and dental specialists are generally beneficial when evaluating for odontogenic sinusitis. Otolaryngologists and dental providers should screen for sinusitis symptoms and dental pain, pathologies, or prior treatments. Generally, for odontogenic sinusitis, otolaryngologists should confirm the sinusitis, and dental specialists should confirm the odontogenic pathology. When there is a potentially treatable dental source of sinusitis, or an unknown source of unilateral sinusitis, patients should be referred to dental specialists for evaluation. When there are CT findings of any maxillary sinus disease, dental providers can refer patients to otolaryngologists to evaluate for sinusitis [37]. Therefore, there are four important aspects of diagnosing odontogenic sinusitis:

- suspecting odontogenic sinusitis based on different clinical features,
- confirming the sinusitis,
- confirming the odontogenic source, and
- the utility of multidisciplinary collaboration.

Thus, the diagnostic process depends on which provider performs the initial evaluation. Otolaryngologists assess for sinusitis, and then refer to dental providers to assess for odontogenic pathology. Dental providers assess for odontogenic infectious pathology, and refer to otolaryngologists to assess for sinusitis [37]. Figure 7 is a flow chart demonstrating the multidisciplinary nature of diagnosing odontogenic sinusitis, through evaluations by both otolaryngologists and dental providers.

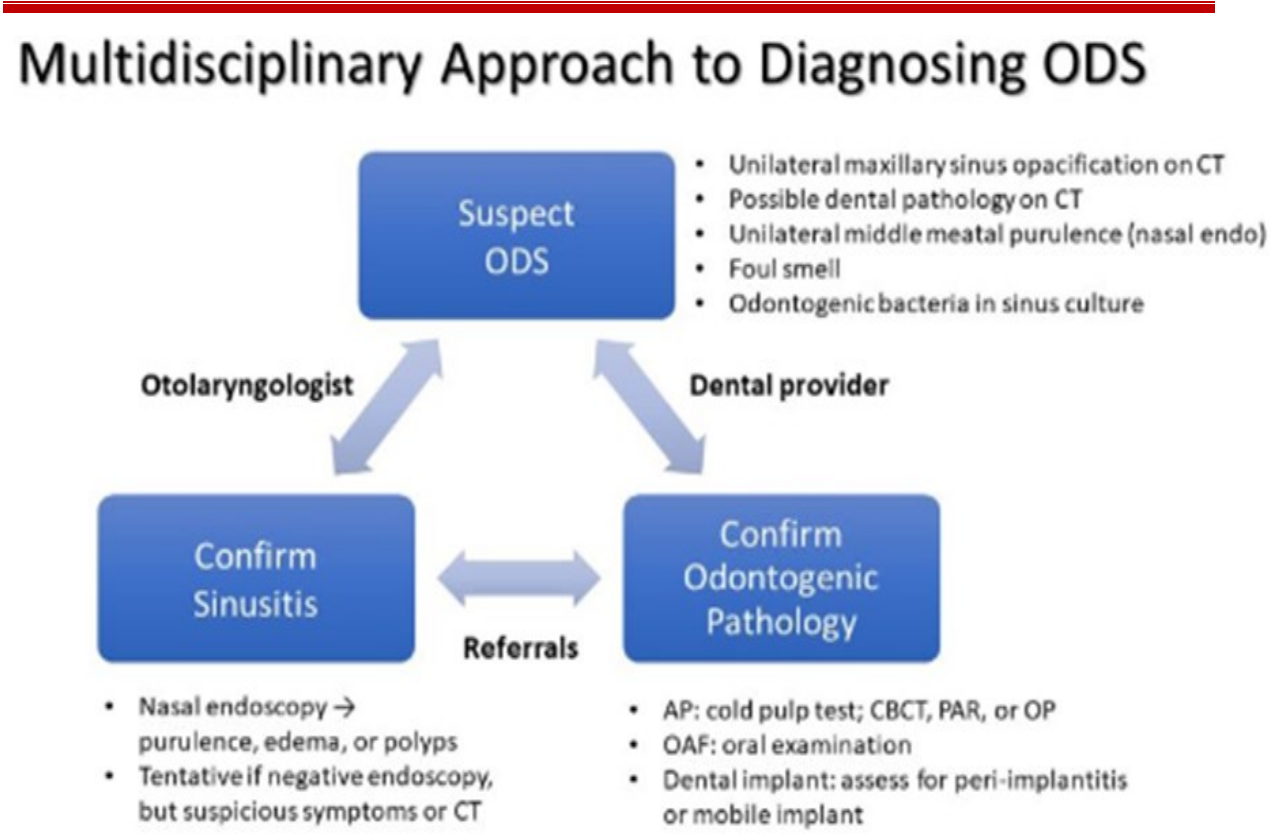


Figure 8: flow chart demonstrating the multidisciplinary nature of diagnosing odontogenic sinusitis [37].

II.5. MANAGEMENT

The treatment of OMS has four goals:

- to fight against infection by removing the pathogenic microorganisms and their by-products,
- fight against pain,
- reduce tissue edema, facilitate drainage and maintenance of sinus ostia patency
- Avoid transition to chronicity and prevent reinfection.

The treatment of odontogenic sinusitis often requires management of the sinusitis as well as the odontogenic origin. As a result, it does not have any gold standard treatment [32]. Literature suggests various treatment options for OMS: medical, dental and surgical treatment.

II.5.1 Medical treatment

Antibiotherapy is the main medical treatment indicated for OMS. The appropriate antibiotherapy for OMS should target both aerobe and anaerobe bacteria, taking into account the most implicated ones and their sensitivity profile. For this reason, amoxicillin combined with clavulanic acid (which is a beta lactamase inhibitor), penicillin, clindamycin, and metronidazole are adequate drugs of initial choice. In patients with confirmed penicillin allergy, oral broad-spectrum cephalosporins (e.g. cefuroxime), fluoroquinolones (e.g. ciprofloxacin) and tetracyclines (e.g. doxycycline) can be used as alternatives [38]. The recommended duration for antibiotherapy is usually ten days.

II.5.2 Dental treatment

In 2018, the American Academy of Endodontics published a position statement on the management of odontogenic sinusitis, suggesting that dental treatment has to be given priority, especially when there is clear evidence of a dental infection source. This may involve:

a) Endodontic treatment (Root canal therapy): Endodontic treatment involves removal of the neurovascular tissue within a tooth (dental pulp) and obturation of the empty canal space with a synthetic material, such as gutta-percha cones.
b) Apicoectomy: It is a dental procedure whereby inflamed gum tissue and the infected end of the root of your tooth is removed and a root end cavity is prepared and filled with biocompatible material. It is an example of a periradicular surgery, often referred to as a root-end resection.
c) Dental extraction: If root canal therapy or apicoectomy is unsuccessful, it is advisable that the offending tooth is extracted. Extraction of maxillary posterior teeth must be done carefully to avoid OAC or even displacement of root tips into the maxillary sinus.

II.5.3 Surgical treatment

Sometimes, dental infection removal alone is sufficient to resolve odontogenic maxillary sinusitis but some other times, concomitant sinusal surgical treatment (especially for foreign intrinsic bodies, that are represented by included teeth or by tooth roots displaced in the maxillary sinus) is necessary for full resolution. This means surgical treatment becomes an option only when OMS shows resistance to medical and dental treatment [39]. The two most used surgical methods are:

a) Caldwell-Luc procedure: It involves complete removal of the antral lining and the creation of a new opening for more dependent drainage into the nose by transoral

approach. By this procedure, a foreign body displaced into the antral cavity can be retrieved with small forceps and with the use of suction through the expanded extraction socket or a bone opening in the canine fossa [40].

b) Endoscopic sinus surgery: ESS is performed under general anesthesia for the treatment of chronic, acute, fungal and bacterial sinusitis, as well as other various sinus pathologies. An endoscope is passed through the nose and provides the view of the infected sinus mucosa, osteomeatal complex condition, polyps, etc. The natural ostium is widened surgically, and only infected sinus mucosa is removed, leaving the basement membrane intact. Thus, natural sinus mucosa is preserved and mucocilliary clearance is not disturbed. Due to the proximal contact to anatomical structures such as the orbital nerve and eyes, this procedure requires high experience and precision [41].

Note: Antral lavage or maxillary sinus puncture is another surgical procedure, though it is obsolete. It involved inserting a cannula into the maxillary sinus via the inferior meatus to allow irrigation and drainage of the sinus. It was mostly used when there is pus accumulation in the sinus [40].

More prospective and rigorous studies are still highly needed to determine the best treatment for each patient affected by odontogenic sinusitis, because a global management consensus has not yet been signed in for the disease. The sheer variety of scenarios that may be encountered should be enough to encourage mutual collaboration between dental practitioners and ENT specialists. Such collaboration is required both to perfect diagnosis and treatment and to provide a solid scientific and medico-legal foundation for each intervention proposed to patients [12]. The figure below summarizes the various treatment methods suggested in the literature [33].

Table 6. Treatment Plans for Odontogenic Maxillary Sinusitis[a]

Reference	Etiology	Treatment plan	Rate of success
Andric et al. (2010) (14)	OAF	FESS + OAF closure	FESS, combined with OAF closure might be an effective treatment for chronic odontogenic sinusitis with OAF.
Khudaibergenov et al. (2011) (27)	OAF	Osteoplastic sinusotomy	They suggested this treatment plan as a simple approach in cases of sinusitis with OAF.
Selmani et al. (2006) (28)	Displaced tooth	Caldwell-Luc	With this approach, the sinuses were radiographically clean after one month after foreign bodies and the infected mucosa were removed.
Costa et al. (2007) (22)	Displaced tooth	ESS	An endoscopic approach to draining all involved sinuses can promote successful closure of OAF.
Huang et al. (2011) (29)	Displaced tooth	Caldwell-Luc	This treatment plan is safe, simple, and fast, with minimal complications for removing displaced teeth.
Chemli et al. (2012) (15)	Displaced tooth	Caldwell-Luc + OAF closure	There were two cases of recurrent sinusitis.
Ippolitov et al. (2004) (30)	Periapical infection	Endoscopy	This treatment method led to a stable cure.
Longhini et al. (2010) (16)	Periapical infection	Tooth extraction + ESS	ESS had been unsuccessful before tooth extraction.
Nurbakhsh et al. (2011) (31)	Periapical infection	RCT	The dental treatment alone did not lead to absolute cure of maxillary sinusitis.
Chemli et al (2012) (15)	Periapical infection	RCT + endoscopy	Nasal endoscopy is a reliable method and has a low rate of complications.

[a]Abbreviations: ESS, endoscopic Sinus surgery; FESS, functional endoscopic sinus surgery; OAF, oroantral fistula; RCT, root canal therapy.

Figure 9: various treatment methods for OMS suggested in the literature[33].

II.5.4 Complications

Lack or delay in treatment of odontogenic maxillary sinusitis may result in worsening of the infection or its penetration to the other paranasal sinuses and the surrounding anatomical structures, like the orbit and the base of the skull. It is associated with serious complications such as encephalitis, meningitis, cavernous sinus thrombosis, and optic neuritis [28]. Though rare, it is possible that OMS leads to orbital abscess, transient blindness, orbital cellulitis, brain abscess, and even osteomyelitis [29].

CHAPTER III: METHODOLOGY

III.1. TYPE OF STUDY

- It was a descriptive cross-sectional study.

III.2. STUDY SITE

- The study was carried out in the dental services of the Biyem Assi District Hospital, CHUY, Etoug-ebe Baptist Hospital, Djoungolo Protestant Hospital, Implantology Laboratory of FMBS, Cabinet Dentaire Adventiste, Cabinet Dentaire Jouvance, Cabinet Dentaire la Reference, Cabinet Dentaire la Couronne, Cabinet Dentaire de Bastos, just to name a few.

III.3. DURATION OF THE STUDY

- The study was carried out from November 2022 to May 2023.
- Data collection was done from January 2023 to April 2023.

III.4. STUDY POPULATION

- The study included every dental surgeon in active service in 2023 registered in the National Order of Dentists in Cameroon, working in the private or public sector within the period of the study, in the city of Yaoundé.

III.4.1. Inclusion criteria

- All dental surgeons who were working in the city of Yaounde at the time of data collection, registered in the National Order of Dentists in Cameroon.
- All dental surgeons who willingly accepted to take part in the study.
- Practitioners who filled out their questionnaire completely.

III.4.2. Exclusion criteria

- All incompletely filled questionnaires.
- Doubling ONCDC registration numbers
- All practitioners who were absent at their duty post at the time of the data collection.

III.5 Sampling

III.5.1. Sampling method

We carried out a consecutive non-probabilistic sampling of all dental surgeons working in the city of Yaoundé.

III.5.2. Sample size

The sample size was calculated using the Cochran formula.

$$n = \frac{Z^2 pq}{d^2}$$

Where n = sample size

Z = standard deviation (1.96)

p = proportion of target population (estimated to be 0.07, based on the fact that we did not find any precedents of a KAP study on this subject)

q = 1 - p

d = degree of accuracy set at 0.05

The substitutions give us a desired sample size of 100 participants.

III.6. Procedure

III.6.1 Administrative procedure

We wrote an application to the National Order of Dental Surgeons in Cameroon to obtain the list and contact information of authorized dental cabinets and registered dental surgeons in Yaoundé. Furthermore, administrative authorizations were obtained from the Directors and/or heads of the dental units in the various hospitals and cabinets mapped out for the study.

III.6.2. Data collection

For data collection, we used a google form for online recruitment and printed questionnaires for offline recruitment. After our protocol was validated, and authorizations obtained from the various institutions concerned, we went to the sites and sought for the eligible personnel for the study. At the site of the study, we introduced ourselves to the potential

participants and explained the aim of the study. After we obtained their consent to carry out the study, each participant was clerked in the appropriate language (French or English) using a pre-established questionnaire (see appendix 2). The questionnaire involved pre-set questions that are designed based on the study objectives with a limited number of multiple choices. It had the following sections:

Section 1: Socio-demographic information (age, gender, number of years in service, type of working place, domain of specialization and bucco-dental school attended).

Section 2: Composed of 10 questions on the knowledge of dental surgeons on odontogenic maxillary sinusitis, followed by 03 questions assessing the need for further education and training.

Section 3: Divided into two subsections-the first 06 questions focused on the attitudes of dental surgeons as regards the management of OMS and the last 06 questions focused on their practices (clinical, preventive, etc.).

The average duration to clerk each participant was 15 minutes.

III.6.3. Studied variables

The variables evaluated during the study were:

- Socio-demographic data: these included age, gender, number of years in service, type of working place, domain of specialization and bucco-dental school attended.
- General knowledge on odontogenic maxillary sinusitis.
- The dental surgeon's attitude towards patients with OMS.
- The dental surgeon's practices in OMS management (evaluation techniques, management and preventive strategies).

III.7. Resources

III.7.1. Human resources

- Investigator (myself)
- The study supervisor
- The co-supervisors
- Collaborators
- A statistician

III.7.2. Material resources.

a. Materials for data collection

- A predesigned questionnaire.
- Ball point pens, pencils, erasers

b. Materials for data analysis

- Laptop computer
- Microsoft word
- Statistical software
- Scientific calculator
- A USB flash disk

III.8. Data analysis

Data from completed and validated questionnaires was entered and analyzed using SPSS 23, Excel 2013. Using a confidence interval of 95%, the major descriptive analysis involved was the calculation of frequencies. The results were presented in figures and tables. The data was reported by using descriptive statistics to produce percentages and displayed using frequency tables, plus graphical illustrations using bar charts. The overall assessment of the knowledge, attitudes and practices of our study sample was done using the fisher's test. p values lower than 0.05 ($p<0.05$) were considered statistically significant.

Assessment of knowledge, attitudes and practices

The knowledge of dental surgeons on OMS was assessed using a 10-point scale. This section had 10 questions and each correct response was given a score of 1, while a wrong response a score of 0. Total points to be scored were 10 and the minimum was 0. Attitudes towards patients with OMS were assessed using 06 questions. For each question, a positive attitude was scored 1 and a negative attitude was scored 0. The responses were summed up and a total was obtained for each respondent. The practices were assessed using 06 questions too. Each correct response was scored 1 and a wrong response was scored 0. Total points to be scored were 6 and minimum was 0. The codification of the obtained percentages was as follows:

- Less than 50 % = Poor knowledge
- 50 % to 64 % = Insufficient knowledge
- 65 % to 84 % = Average knowledge
- 85 % and above = Good knowledge

The same codification was used for attitudes and practices [55].

III.9. Ethical considerations

The project proposal and the questionnaire were submitted to the Ethical Committee of the Faculty of Medicine and Biomedical Sciences of the University of Yaounde I, for ethical evaluation and clearance. In the meantime, we wrote an application to the National Order of Dental Surgeons in Cameroon to obtain the list and contact information of dental cabinets and registered dental surgeons in Yaoundé. Furthermore, administrative authorizations were obtained from the Directors and/or heads of the dental units in the various hospitals and cabinets we used for the research.

A consent form was given to each participant to read and sign (both online and offline). A participant could withdraw from the study anytime he or she wished to. All information obtained or used in the study was treated as confidential. Participants' names did not appear on any research document. All data gathered from them was coded to protect their identity and privacy. This was in strict respect of the fundamental principles of medical research as recorded in the Helsinki declaration. These principles include:

- The principle of interest and the benefit of the research.
- The principle of safety of the research.
- The principle of confidentiality.
- The principle of justice.

CHAPTER IV: RESULTS

During our study, we enrolled 115 dental surgeons and retained 97. Out of the 97 participants, 31 responded through the online Google form (31.96 %), while the rest (68.04 %) responded through the printed questionnaires.

IV.1. Socio-demographic data.

IV.1.1. Gender

Out of the 97 participants in the study, 54 of them were males (55.7 %) while 43 were females (44.3 %).

IV.1.2. Age

The modal age group of participants was between 20-40years, with a percentage of 92.8 % of the study population.

IV.1.3. Type of working place

Most of our participants were working in private hospitals and clinics, which represented 68.0 %. The table below shows the socio-demographic characteristics of our study population.

Table 1: distribution of socio-demographic data of dental surgeons (Yaounde: February 2023-April 2023).

Variables	Modalities	Number (n)	Percentage (%)
Gender			
	Male	54	55.7
	Female	43	44.3
Age in years			
	20-40 years	90	92.8
	41-64years	7	7.2
Type of working place	Public hospitals	31	32.0
	Private clinics and Private dental cabinets	66	68.0

IV.2. Technical description of study population

IV.2.1. Number of years in service

The modal group for number of years in service was between 1-5years, with a percentage of 70.1 % of the study population, followed by 6-10years (20.6 %).

IV.2.2. Domain of specialization

92.8 % of our participants were general dental practitioners, a numerical value of 90 out of the 97 participants. Only 7.2 % were specialists.

IV.2.3. Bucco-dental school attended

60.8 % of our participants studied at the Faculty of Medicine and Biomedical Sciences, 23.7 % studied at UDM Bangangte, and the rest studied out of the country.

The table below summarizes the technical distribution of our study population.

Table 2: technical distribution of our study population – dental surgeons (Yaounde: February 2023-April 2023).

Variables	Modalities	Number	Percentage (%)
Number of years in service	**1-5**	**68**	**70.1**
	6-10	20	20.6
	11-15	2	2.1
	16-20	5	5.2
	21-25	1	1.0
	26-30	1	1.0
Domain of specialization	**General practitioner**	**90**	**92.8**
	Endodontics	1	1.0
	Maxillofacial surgery	3	3.1
	Orthodontics	2	2.1
	Implantology	1	1.0
Bucco-dental school attended	**FMBS Yaounde**	**59**	**60.8**
	UDM Bangangte	23	23.7
	Dakar	1	1.0
	AUP	3	3.1
	UNIKIN	4	4.1
	Germany	2	2.1
	IOSTM Madagascar	2	2.1
	University of Western Cape	1	1.0
	Russia	2	2.1

IV.3. General knowledge on odontogenic maxillary sinusitis

The table below summarizes the knowledge of participants on the definition, risk factors and causes of odontogenic maxillary sinusitis.

Table 3: knowledge of dental surgeons on the definition, risk factors and causes of odontogenic maxillary sinusitis (Yaounde: February 2023-April 2023).

Variables	Modalities	Number	Percentage (%)
OMS is a symptomatic inflammation of the maxillary sinus as a result of a dental pathology or dental procedures	No	1	1.0
	Yes	**96**	**99.0**
The diagnosis of OMS requires multidisciplinary collaboration between otolaryngologists and dental providers	No	10	10.3
	Yes	**87**	**89.7**
Infection of posterior maxillary teeth is a risk factor for OMS	No	20	20.6
	Yes	**77**	**79.4**
Infection of anterior maxillary teeth is a risk factor for OMS	**No**	**29**	**29.9**
	Yes	68	70.1
Iatrogenic factors such as dental implants and complications of dental extractions are risk factors for OMS	No	3	3.1
	Yes	**94**	**96.9**
Infection of anterior mandibular teeth is a risk factor for OMS	**No**	**94**	**96.9**
	Yes	3	3.1
Infection of posterior mandibular teeth is a risk factor for OMS	**No**	**91**	93.8
	Yes	6	6.2
Oroantral fistulas can cause OMS	No	26	26.8
	Yes	**71**	**73.2**
Implant displacement into the sinus can cause OMS	No	13	13.4
	Yes	**84**	**86.6**
Migration of a tooth or root into the sinus during dental extraction can cause OMS	No	9	9.3
	Yes	**88**	**90.7**
Endodontic treatment poorly done can lead to OMS	No	23	23.7
	Yes	**74**	**76.3**
Dental caries can lead to OMS	No	51	52.6
	Yes	**46**	**47.4**
Periapical infections can lead to OMS	No	4	4.1
	Yes	**93**	**95.9**
Periodontal disease can cause OMS	No	50	51.5
	Yes	**47**	**48.5**
Odontogenic cysts can cause OMS	No	15	15.5
	Yes	**82**	**84.5**

As seen on the table above, just about 1 % of our participants failed to get the definition of odontogenic maxillary sinusitis. 10.3 % did not see any need for a multidisciplinary collaboration between otolaryngologists and dental providers in the diagnosis and/or treatment

of OMS. 20.6 % did not agree that the infection of posterior maxillary teeth is a high risk factor for odontogenic maxillary sinusitis. Iatrogenic factors constituted the highest risk factors (96.9 %). Majority of participants (95.9 %) said periapical infections could equally lead to OMS.

Out of the 97 participants, 37.1 % said the maxillary second premolar was the tooth with the highest probability of causing OMS, followed by the maxillary first molar (26.8 %). This distribution can be shown in the figure below.

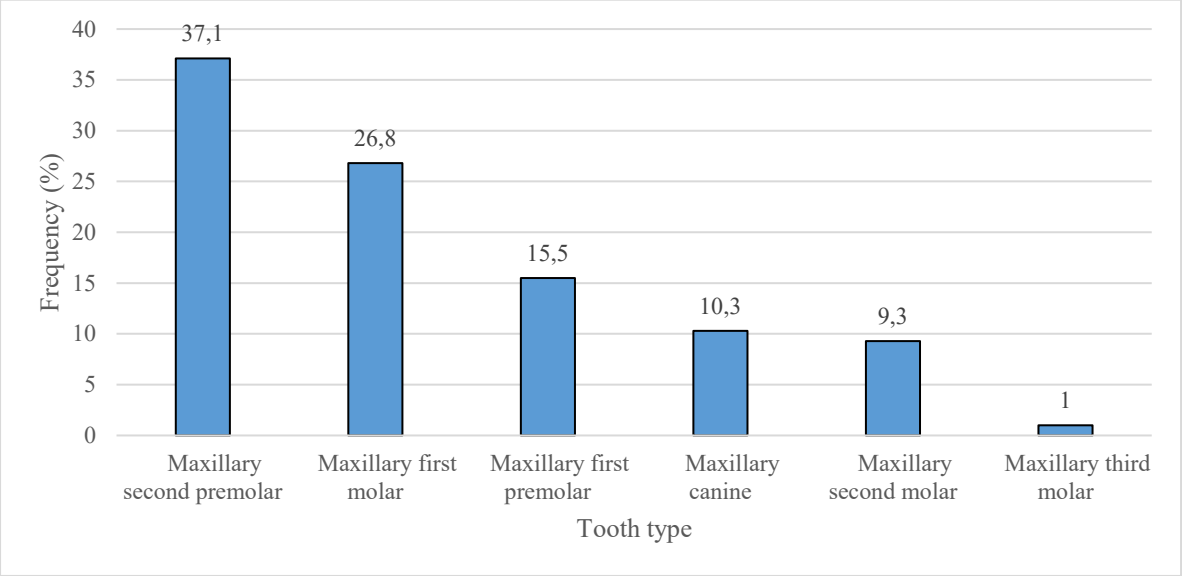


Figure 10: tooth with the highest probability of causing OMS

For clinical signs, most participants ranked nasal congestion highest (91.8 %), followed by purulent anterior rhinorrhea (90.7%). This information is summarized by the figure below.

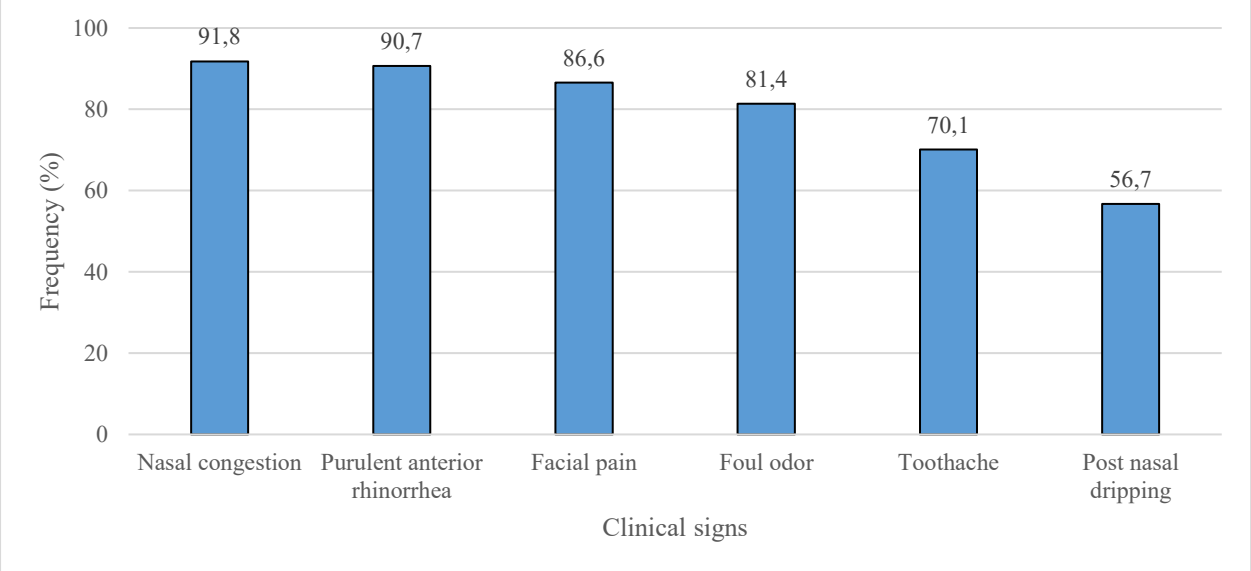


Figure 11: clinical signs of OMS

As pertains to complications, majority of our participants said orbital cellulitis was a possible complication of OMS (92.8 %), whereas 2.1 % of our participants did not know any complications linked to OMS. This distribution can be shown in the figure below.

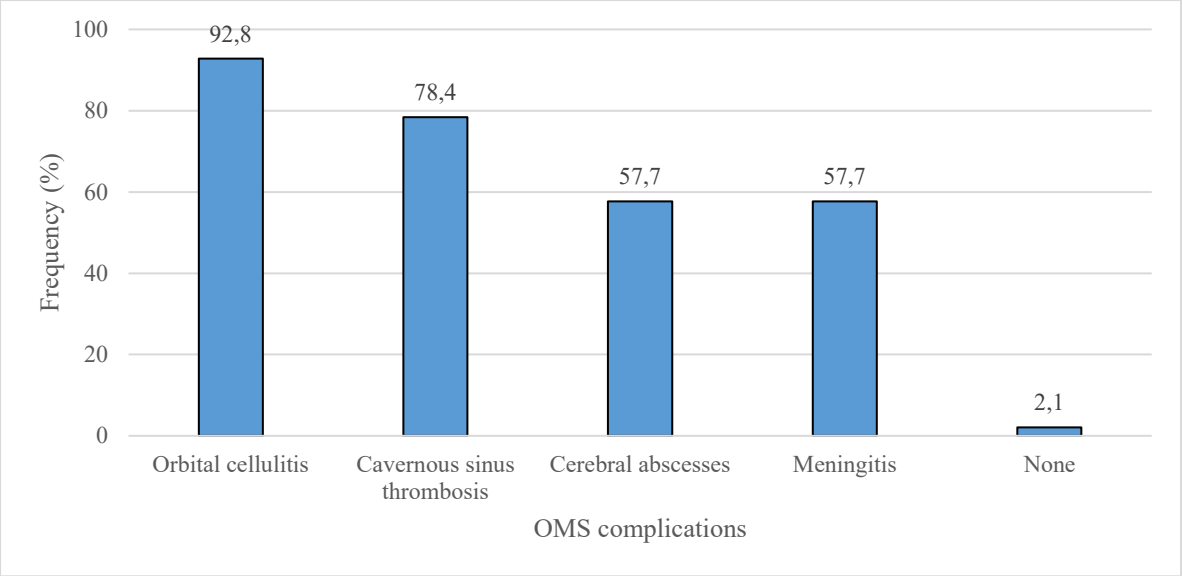


Figure 12: complications of OMS

IV.3.1 Knowledge on the management of odontogenic maxillary sinusitis

On the various treatment proposals for OMS, antibiotherapy was ranked the highest (96.9 %), followed by dental treatment (95.9 %). 4.1 % of our participants did not know any treatment proposal for OMS. The figure below summarizes this information.

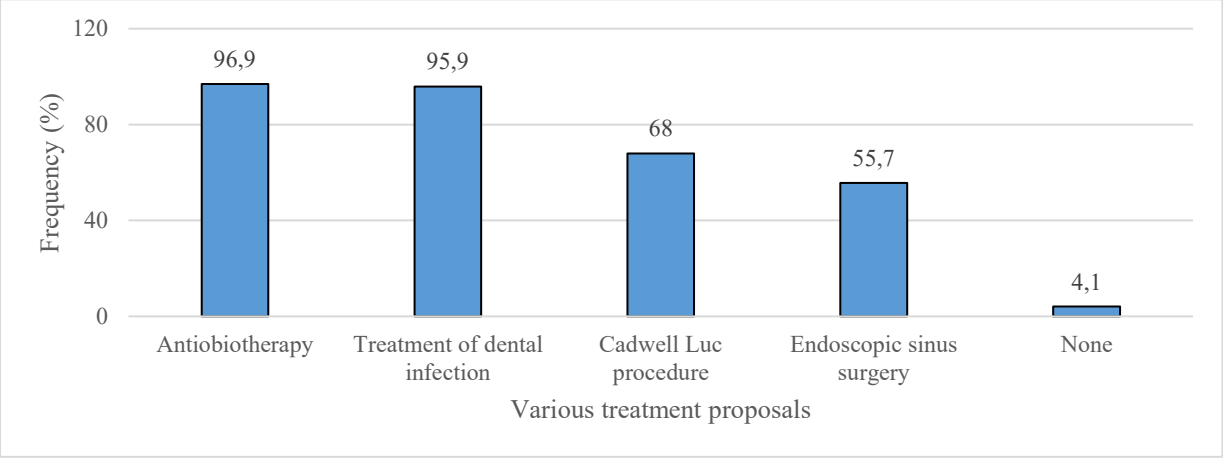


Figure 13: various treatment proposals for OMS

Concerning which antibiotics participants will recommend for the treatment of OMS, most participants said they will recommend Amoxicillin-clavulanate (83.5 %). The distribution of the various antibiotics of choice are represented in the figure below.

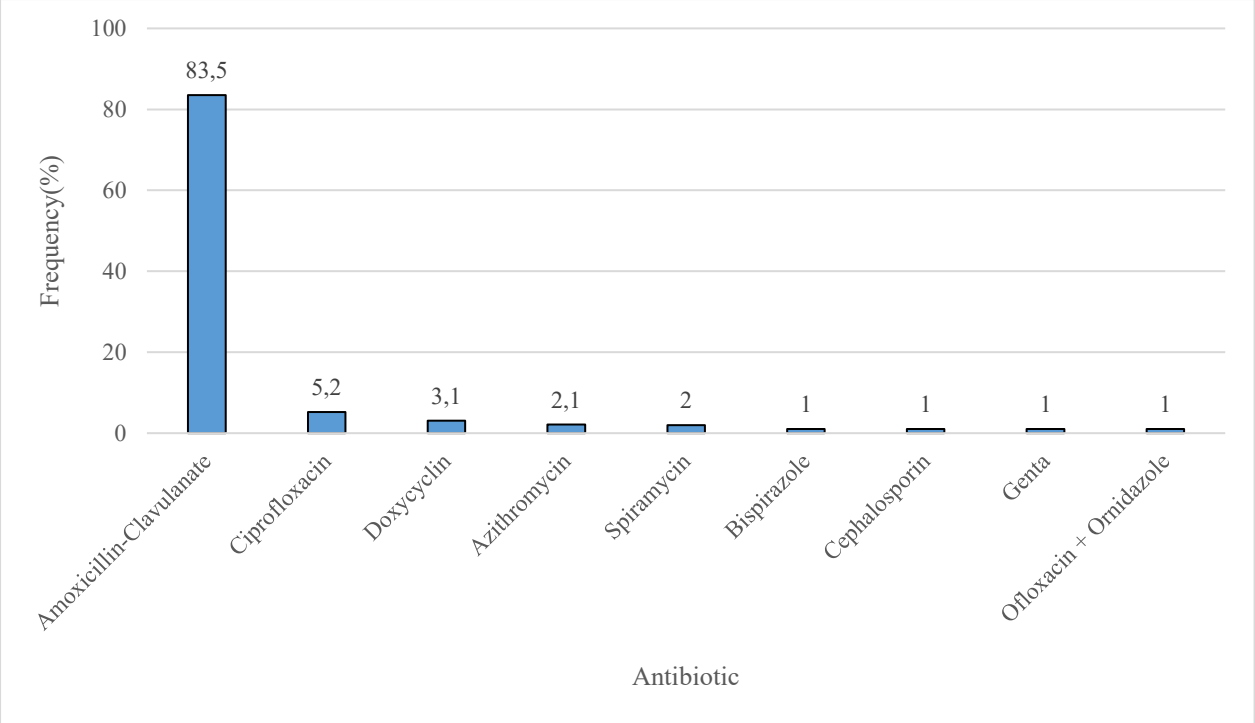


Figure 14: various antibiotics used in the treatment of OMS

On which dental treatment could help in the management of OMS, extraction was the treatment option of choice (89.7 %), followed by endodontic treatment (68.0 %). This distribution can be shown in the figure below.

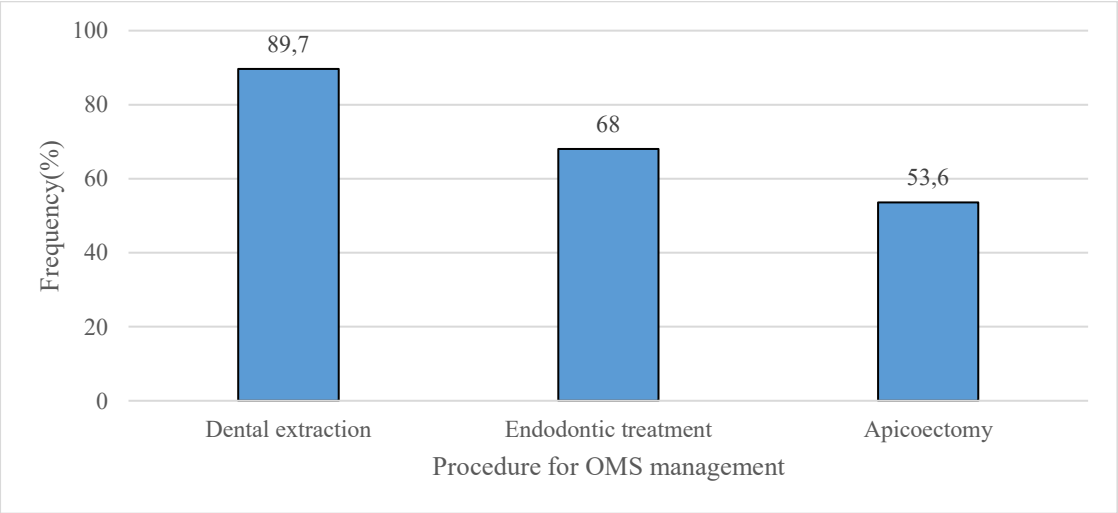


Figure 15: various dental procedures used for the treatment of OMS

IV.3.2 Education and training in OMS management

82.5 % of our participants said they had never received any proper education or special training on OMS management. 87.6 % of this category expressed the desire to be trained to this effect. For the few who attested to have received some education and training, 21.1 % said their

training was on the surgical management of OMS. 52.6 % said theirs was on medical management and 10.5 % said theirs was in the use of radiology for the diagnosis of OMS. The distribution is shown in the table below.

Table 4: need for education and training in OMS management amongst dental surgeons (Yaounde: February 2023-March 2023)

Variables	Modalities	Number	Percentage (%)
Since you started working, have you undergone any special training in OMS management	No	80	82.5
	Yes	17	17.5
If no, do you think you need the training	No	12	12.4
	Yes	85	87.6

From our study, a statistical significance was found to exist between modal age group, domain of specialization and participants need for special training. The table below illustrates this.

Table 5: dental surgeons need for special training in OMS management according to their domain of specialization and age (Yaounde: February 2023-April 2023)

Characteristic	Yes, N = 17[1]	No, N = 80[1]	p-value[2]
Specialization			p=0,0162
Chirurgie maxillo-faciale/Maxillofacial surgery	0 (0.0%)	3 (100.0%)	
Dentiste général/General dentistry	14 (15.6%)	76 (84.4%)	
Endodontrie/Endodontics	0 (0.0%)	1 (100.0%)	
Implantology	1 (100.0%)	0 (0.0%)	
Orthodontie/Orthodontics	2 (100.0%)	0 (0.0%)	
Age			p=0.0168
20-40	13 (14.4 %)	77 (85.6 %)	
41-64	4 (57.1 %)	3 (42.9 %)	

[1] n (%)

[2] Fisher's exact test

IV.4. Attitudes and practices towards patients with odontogenic maxillary sinusitis

IV.4.1 Barriers encountered as regards the treatment of OMS

With regards to the various barriers encountered in the treatment of OMS, lack of education was the most highlighted (34 %). The figure below gives the summary.

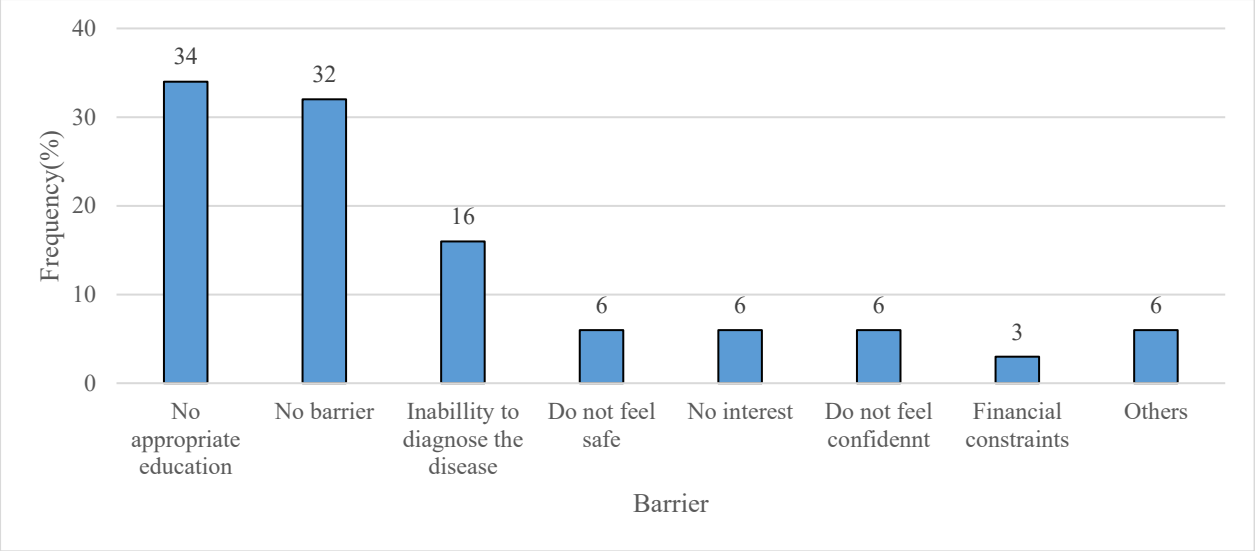


Figure 16: barriers encountered in the treatment of OMS

IV.4.2 Average number of cases received per month

Out of the 97 participants, 37.1 % said they receive an average number of one OMS case per month. The various distributions are shown in the figure below.

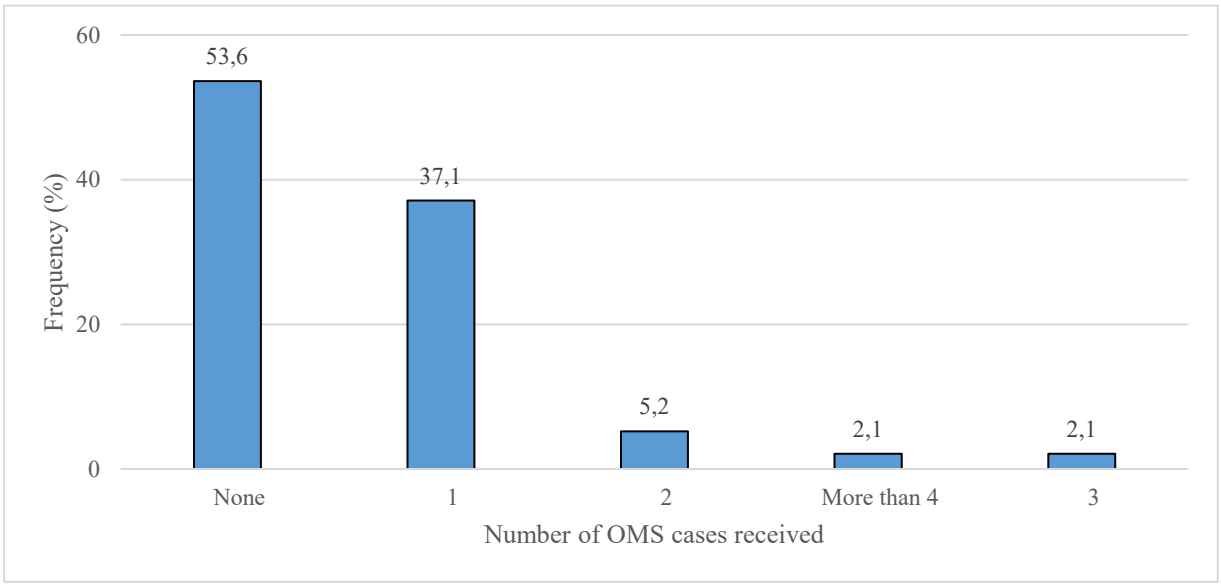


Figure 17: average number of OMS cases received per month

IV.4.3 Attitudes (diagnostic ease, referral, precaution necessity and comfortability quotient vis-à-vis OMS management)

33.0 % of those who participated in our study said they find it difficult to diagnose sinusitis of dental origin in their daily practice. 42.3 % said they do not see any need to refer a patient to an

ENT specialist once they are able to identify and treat the dental source of the sinusitis. 46.4 % said they had treated cases of OMS that were referred to them by ENT specialists. 25.8 % said they do not feel comfortable handling OMS cases. 10.3 % said they do not take any precautions when treating antral teeth. The table below illustrates these results.

Table 6: diagnostic ease, referral, precaution necessity and comfortability quotient vis-à-vis OMS management amongst dental surgeons (Yaounde: February 2023-March 2023)

Variables	Modalities	Number	Percentage (%)
Do you find it easy to diagnose sinusitis of dental origin	No	32	33.0
	Yes	65	67.0
In your point of view, is it necessary to still refer cases of OMS to the ENT service when you have identified the odontogenic source and treated it	No	41	42.3
	Yes	**56**	**57.7**
In your practice so far, have you treated any patient with OMS that was referred to your service by an ENT specialist	No	52	53.6
	Yes	45	46.4
Do you feel comfortable treating patients with OMS	No	25	25.8
	Yes	72	74.2
Do you take any precautions when treating sinus-related teeth in your daily practice	No	10	10.3
	Yes	87	89.7

IV.4.4 Treatment methods participants have used in their daily practice

From our study, we observed that the treatment method of choice per case depended on the discretion of the dental surgeon. The figure below attests to this reality.

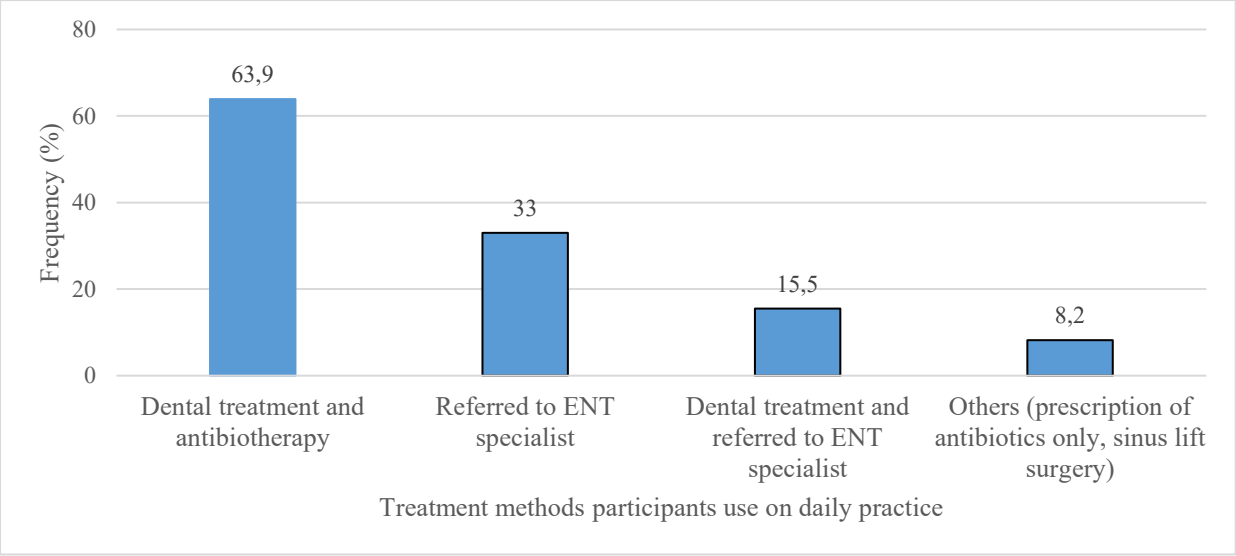


Figure 18: treatment methods participants use on daily basis

IV.4.5 Clinical methods used in daily practice

97.9 % of our participants used thorough dental and medical examination to clinically diagnose the disease.

Table 7: clinical methods used for the diagnosis of OMS by dental surgeons in daily practice (Yaounde: February 2023-April 2023)

Variables	Modalities	Number	Percentage (%)
Clinical methods			
- Experimenting using common sense	No	53	54.6
	Yes	44	45.4
- Active listening (interviewing)	No	29	29.9
	Yes	68	70.1
- Thorough dental and medical examination	No	2	2.1
	Yes	95	97.9
- Comprehensive history taking	No	9	9.3
	Yes	88	90.7

IV.4.6 Paraclinical assessment of odontogenic maxillary sinusitis

Most of our participants prescribed panoramic radiography as their imaging technique of choice in diagnosing OMS (68.0 %). The various distributions are shown in the figure below.

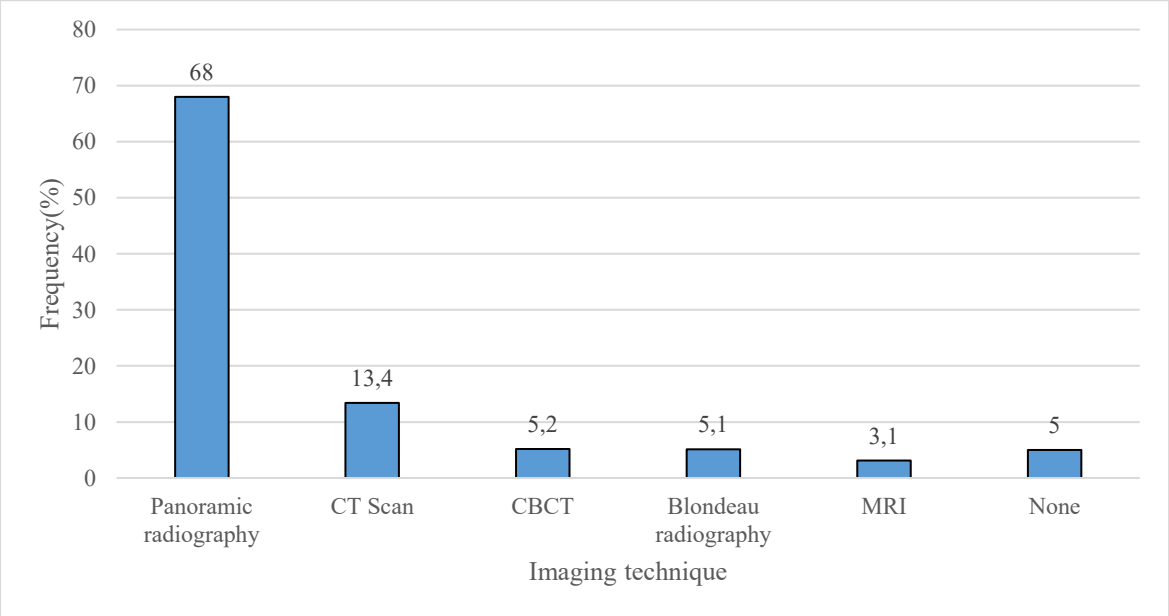


Figure 19: imaging techniques used in the assessment of OMS

IV.4.7 OMS prevention methods

Out of the 97 dental surgeons who participated in our study, 89.7 % said they take precautions when treating posterior maxillary teeth or antral teeth. This means that 10.3 % of our

participants approached the treatment of antral teeth like every other teeth (no special considerations). Amongst those who said they took precautions, 61.9 % said they use the Valsalva maneuver after the extraction of an antral tooth to determine if there is oroantral communication and 10.3 % said they use retroalveolar X-rays before commencing treatment procedures on antral teeth and for follow up.

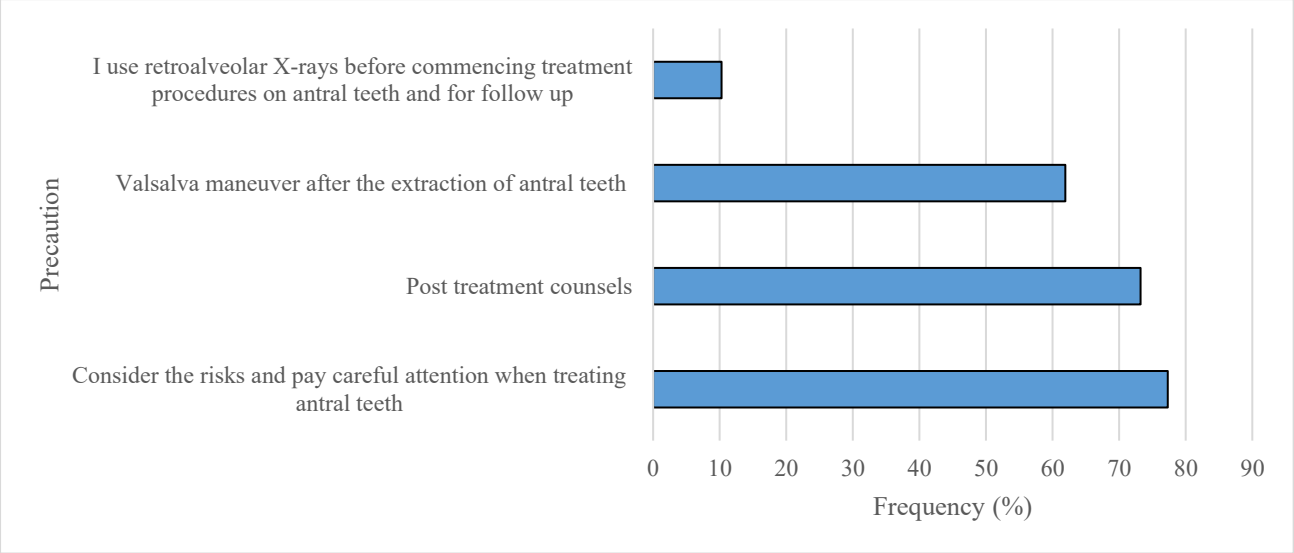


Figure 20: precautions when treating posterior maxillary teeth

Amongst those who said they gave post treatment counsels, 89.7 % said they counselled patients against smoking cigarettes after the extraction of antral teeth as a preventive measure against sinus infection. The figure below summarizes these post extraction counsels.

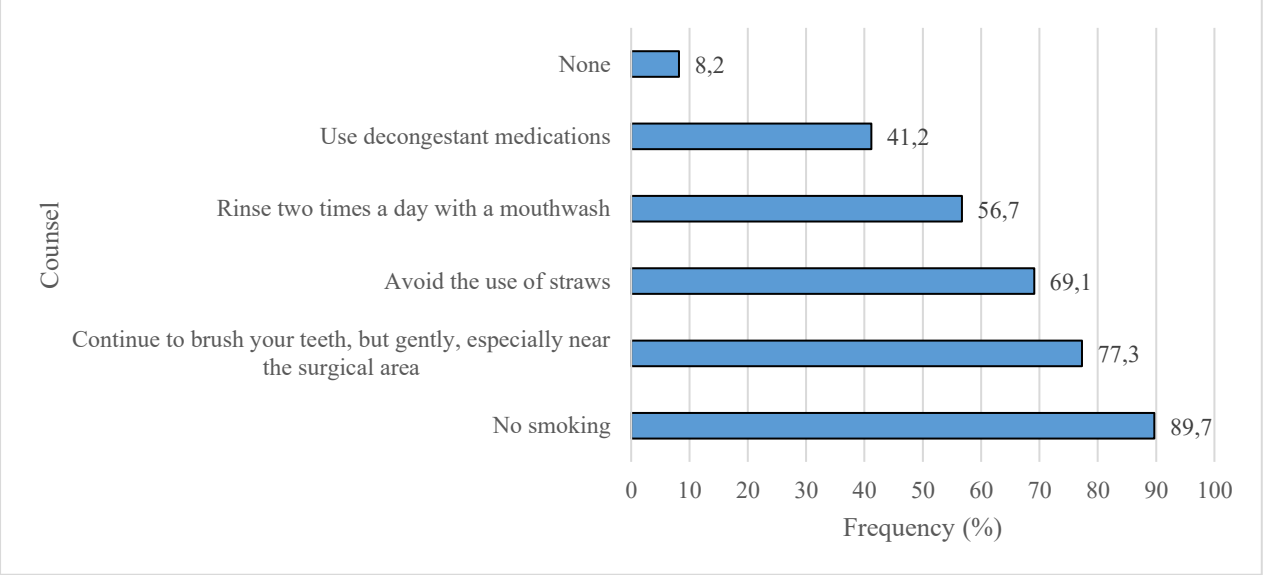


Figure 21: post extraction counsels against sinus infection

IV.5. Overall score and rating for knowledge, attitudes and practices.

- For knowledge, 53 (54.6 %) of the participating dental surgeons had an average knowledge on odontogenic maxillary sinusitis, 4 (4.1 %) had a good knowledge, 32 (33.0%) had insufficient knowledge and 13 (13.4 %) had a poor knowledge.
- For attitudes, 32 (33.0 %) of the participating dental surgeons had attitudes that fall within the average range, 4 (4.1 %) had good attitudes, 32 (33.0 %) had attitudes that fall within the insufficient range and 29 (29.9 %) had poor attitudes.
- For practices, 39 (40.2 %) of the participating dental surgeons had practices that fall within the average range, 29 (29.9 %) had practices that fall within the insufficient range, 25 (25. 8 %) had poor practices and 4 (4.1 %) had good practices.

The table below summarizes the overall score and rating for knowledge, attitudes and practices.

Table 8: overall score and rating for knowledge, attitudes and practices (Yaounde: February 2023-March 2023)

Characteristic	**N = 97**[1]
Knowledge	
Average	53 (54.6 %)
Good	4 (4.1 %)
Insufficient	27 (27.8 %)
Poor	13 (13.4 %)
Attitude	
Average	32 (33.0 %)
Good	4 (4.1 %)

Characteristic	N = 97[1]
Insufficient	32 (33.0 %)
Poor	29 (29.9 %)
Practice	
Poor	25 (25.8 %)
Insufficient	29 (29.9 %)
Average	39 (40.2 %)
Good	4 (4.1 %)

[1] n (%)

CHAPTER V: DISCUSSION

Odontogenic maxillary sinusitis is a well-known but understudied form of sinusitis that requires a unique treatment regimen. There is no precedence of any KAP study on the condition globally and there is very limited data on the condition in Cameroon. It is easily misdiagnosed and this often leads to poor management [5]. Because it is a border condition between otorhinolaryngology and dental science, diagnosis and/or management most often demands proficuous collaboration between the dentist and an ENT specialist. It is therefore important for the dentist to understand his unique role in the management and prevention of this condition. In this study, we sought to assess the knowledge dental surgeons have on odontogenic maxillary sinusitis, their attitudes towards it, and their practices in preventing or treating it. Our study revealed that dental surgeons have limited or average knowledge (54.6 %) as regards the management of odontogenic maxillary sinusitis, resulting in mediocre attitudes (33.0 %) and practices (40.2 %). 34.0 % of the participating dental surgeons agreed to having an educational barrier on the disease. This was corroborated with the fact that most of them (82.5 %) had not received any special training for the management of OMS. One of the reasons for the prevalence of this ignorance is the fact that despite all the general and robust literature on rhinosinusitis, very little has been properly documented on OMS management as a unique condition [42].

V.1. Socio-demographic variables

The modal age group for our study was 20-40 (92.8 %), with a male predominance (55.7 %). This is in contrast with the study carried out by Agbor *et al.* in 2014, which showed that there was female predominance (53.4 %) in the dental profession in Cameroon [43]. There was a significant association between the modal age group and need for special training in OMS management. The younger population of dental surgeons expressed less need for training than the older generation. This was rather unexplainably ironical, as one would have expected that the experience of the older generation over the years would have given them more expertise on the management of the disease, unlike the younger generation, many of which attested to have seen or handled very few cases of OMS. A vast majority of our participants were general dental practitioners (92.8 %). A statistical significance was found to exist between the domain of specialization and participants need for special training in OMS management. More general practitioners saw the need to be trained in OMS management as compared to specialists. The reason for this can be the fact that other specialties like maxillofacial surgery obviously have advanced training that gives them an upper hand in the face of this condition. Even the mere fact that most of our participants were practicing general dentistry supports this statistical significance. Most of our participants were working in private hospitals and clinics (68.0 %).

This can be explained by the fact that very few dental surgeons have been integrated into public service in Cameroon in recent years and also because of the complex administrative protocol involved in securing authorization to carry out research in some public hospitals. Most of the participants who studied abroad had a better understanding of the need for a multidisciplinary approach to diagnose and/or treat OMS (13.5 %). Conversely, most of those who saw no need to involve an ENT specialist in the process (42.3 %) were amongst dental surgeons who studied in Cameroon. This can be linked to the fact that most of our participants who studied abroad were specialists and hence understand the limitations of a general practitioner in this case.

V.2. Knowledge of dental surgeons on odontogenic maxillary sinusitis

In our study, 89.7 % of the study population agreed that the diagnosis and/or treatment of OMS requires multidisciplinary collaboration between otolaryngologists and dental providers. This is in line with the study done by Sabiene *et al.* in 2021 which reiterated the need for a multidisciplinary approach to the diagnosis and management of OMS [12]. As already mentioned, most of those who saw the need for this collaboration studied abroad. Majority of those who studied in our faculties here in Cameroon saw no need for a multidisciplinary approach. A good number of them rather preferred to just prescribe antibiotics or only treat the dental source of the infection. This can probably be explained by differences in training. Majority of our participants (79.4 %) agreed that the infection of posterior maxillary teeth (antral teeth) is a high risk factor for odontogenic maxillary sinusitis. This ties with the study done by Ohyama *et al.*[44], Tian *et al.*[45] and Garcia *et al.*[19]. Iatrogenic factors constituted the highest risk factors (96.9 %). This is in line with most literature reviews. Periapical infections accounted for 95.9 %, implant displacement into the sinus stood at 86.6 %, OAF accounted for 73.2 %, periodontal disease for 48.5 % and odontogenic cysts for 84.5 %. These findings are in tandem with the findings from the study carried out by Akhlaghi *et al.* on the causes of OMS from January 1980 to January 2013, among 674 patients. It showed that iatrogenic causes accounted for 65.7 % of cases, apical periodontitis for 25.1 % (apical periodontitis-16%, apical granulomas-5 %, odontogenic cysts-2.5 %). According to the study, iatrogenic causes included impacted tooth after dental care, artificial implants, dental amalgams and OAF. In a more recent systematic review, Akhlaghi *et al*. demonstrated that OAF, as a complication of tooth extraction, was the most common cause of OMS among all dental etiologies [11]. The narrative review done by Green *et al.* in 2006 on the prevalence of odontogenic sinusitis supports these facts. According to it, the iatrogenia was by far the leading cause of OMS (55.9 %) [7].

Out of the 97 participants, majority (37.1 %) said the maxillary second premolar was the tooth with the highest probability of causing OMS, it was followed by the maxillary first molar (26.8 %), maxillary first premolar (15.5 %), maxillary canine (10.3 %), maxillary second premolar (9.3 %) and maxillary third molar (1.0 %). Whereas according to Akhlaghi *et al.*, the teeth most affected were, in order of frequency, the first molar (35.6 %), second molar (22 %), third molar (17.4 %), and second premolar (14.4 %) [11]. Green *et al.* agrees with the position of Akhlaghi *et al.* [7]. For clinical signs, most participants ranked nasal congestion highest (91.8 %), followed by purulent anterior rhinorrhea (90.7%), facial pain (86.6 %), foul odor (81.4 %), toothache (70.1 %) and postnasal dripping (56.7 %). These findings are in accord with most studies [14, 26]. However, most literature reviews posit that dental pain is not a very frequent symptom of OMS [4]. According to Craig *et al.,* a patient can have OMS with very mild or no corresponding toothache [35].

As pertains to complications, majority of our participants said orbital cellulitis was more common (92.8 %), followed by carvenous sinus thrombosis (78.4 %), cerebral abscesses (57.7 %), meningitis (57.7 %), whereas 2.1 % of our participants did not know any complications linked to OMS. In Cameroon, Ahounkeng Nanda P *et al*. in their study of sinus pathologies in children in Yaoundé reported 66.67 % ophthalmological complications including 50 % orbital cellulitis (3 cases) and 16.67 % periorbital abscesses [46]. In Morocco Daoudi A *et al*. [47] found 85 % of preseptal cellulitis and 15 % of retrospective cellulitis.

V.2.1. Knowledge on the management of odontogenic maxillary sinusitis

When participants were asked to pick treatment options for OMS, most picked antibiotherapy (96.9 %), followed by dental treatment (95.9 %), CLP (68 %) and ESS (55.7 %). 4.1 % did not know any treatment option for OMS. The mere fact that up to 4.1 % of our participants didn't know what to do at all if they receive a patient suffering with OMS reveals a serious need for education and training on OMS management amongst dental surgeons in the nation. The antibiotic of choice by most participants was amoxicillin-clavulanate (83.5 %), followed by ciprofloxacin (5.2 %) and doxycycline (3.1 %). This is supported by many literature reviews [38]. There were also mentions of azithromycin, spiramycin, bispirazole and gentamicin. When asked which therapeutic dental procedure had the tendency to quickly resolve OMS, most participants said extraction (89.7 %), 68 % said endodontic treatment and 53.6 % said apicoectomy. In a study aimed at proposing appropriate management for odontogenic chronic rhinosinusitis, in March 2020, Tsuzuki *et al.* did a retrospective analysis on thirty-one adult

patients with odontogenic chronic rhinosinusitis undergoing maxillary extraction. Patients with and without oroantral fistula on computed tomography were classified. Functional endoscopic sinus surgery was performed when sinusitis did not improve after extraction. The critical indicators for surgical requirement in the management of odontogenic chronic rhinosinusitis were analysed. The results showed that sinusitis significantly improved after extraction in both groups. Patients without oroantral fistula had significantly more severe remnant sinusitis than those with oroantral fistula after extraction on computed tomography ($p = 0.0037$). The requirement for functional endoscopic sinus surgery was statistically significant for patients without orofacial fistula over those with orofacial fistula ($p < 0.0001$). The surgical improvement ratio was 93 per cent [48].

V.2.2. Education and training in OMS management

Majority of our participants said they had never received any proper education or special training on OMS management (82.5 %). 87.6 % of this category expressed the desire to be trained to this effect. For the few who attested to have received some education and training, 21.1 % said their training was on the surgical management of OMS. 52.6 % said theirs was on medical management and 10.5 % said theirs was in the use of radiology for the diagnosis of OMS. There was a statistical significance between the number of years in service and training. Most of those who attested to have been trained had been in service for at least 10years. Therefore, one of the reasons why majority of our participants had not received any training is because majority of them were young dental surgeons, most of which had not worked for up to 10years. Another reason as revealed by our study could be the fact that OMS is relatively scarce (though recent literature reveals that the diseases appears to be increasing over the last decade) [8]. Out of the 97 participants that took part in our study, 37.1 % attested receiving at least one case of OMS per month. Hoskison *et al.* did a study in September 2011 to proof that there was evidence that cases of OMS had increased reasonably over the last decade in the UK [49].

Overall on knowledge, 53 (54.6 %) of the participating dental surgeons had an average knowledge on odontogenic maxillary sinusitis, 4 (4.1 %) had a good knowledge, 32 (33.0 %) had insufficient knowledge and 13 (13.4 %) had a poor knowledge. This confirms our hypothesis which stated that dental surgeons have limited knowledge on odontogenic maxillary sinusitis. Like already discussed above, this can be explained by the fact that there is limited literature on OMS as a unique disease. Most of the literature on the subject is mentioned just passively in most textbooks as a type of rhinosinusitis [42].

V.3. Attitudes and practices of dental surgeons towards patients with OMS

V.3.1. Diagnostic ease, referral and comfortability quotient vis-à-vis OMS management

Up to 33.0 % of those who participated in our study said they find it difficult to diagnose sinusitis of dental origin in their daily practice. It was understandable because one of the undeniable challenges with diagnosing odontogenic sinusitis is that patients often require evaluations by both otolaryngologists and dental providers. If patients present initially to otolaryngologists, patients' clinical presentations can mimic non-odontogenic rhinosinusitis, and odontogenic sources may not be suspected. Similarly, if patients present first to dental providers with maxillary dental pathology, sinusitis can be overlooked. Another diagnostic hurdle is that optimal dental testing and imaging to confirm specific dental pathologies causing odontogenic sinusitis may not always be performed, which could lead to false negative dental evaluations. This is why in a research carried out by Craig *et al.* in 2021, a strong consensus was reached; that multidisciplinary evaluations by both otolaryngologists and dental specialists are generally beneficial when evaluating for odontogenic sinusitis. Otolaryngologists and dental providers should screen for sinusitis symptoms and dental pain, pathologies, or prior treatments. Generally, for odontogenic sinusitis, otolaryngologists should confirm the sinusitis, and dental specialists should confirm the odontogenic pathology. When there is a potentially treatable dental source of sinusitis, or an unknown source of unilateral sinusitis, patients should be referred to dental specialists for evaluation. When there are radiographic findings of any maxillary sinus disease, dental providers can refer patients to otolaryngologists to evaluate for sinusitis. Therefore, there are four important aspects of diagnosing odontogenic sinusitis: suspecting odontogenic sinusitis based on different clinical features, confirming the sinusitis, confirming the odontogenic source, and the utility of multidisciplinary collaboration. Thus, the diagnostic process depends on which provider performs the initial evaluation. Otolaryngologists assess for sinusitis, and then refer to dental providers to assess for odontogenic pathology. Dental providers assess for odontogenic infectious pathology, and refer to otolaryngologists to assess for sinusitis [35].

42.3 % of our participants said they do not see any need to refer a patient to an ENT specialist once they are able to identify and treat the dental source of the sinusitis and 46.4 % said they had treated cases of OMS that were referred to them by ENT specialists. From this data, we deduce that as concerns the management of OMS, ENT specialists have a higher collaboration tendency than dental surgeons. 25.8 % of our participants said they do not feel comfortable handling OMS

cases. This can be linked to the deficiency in education and training on the management of the disease, which was discovered during the study.

V.3.2. Treatment methods participants have used in their daily practice

With regards to the various barriers encountered in the treatment of OMS, most participants highlighted lack of education (34 %), others highlighted the inability to diagnose the disease (16 %), 6 % said they did not feel safe, 6 % said they did not have interest and 6 % said they lacked confidence. A few others mentioned financial constraints on the part of patients (3 %). From our study, we observed that the treatment method of choice for OMS, per patient, depended on the discretion of the dental surgeon. There were those who said their approach was to treat the dental source first and prescribe antibiotics (63.9 %). Others said they simply referred the patients to the ENT service (33 %), others said their approach was to treat the dental source first before referring to the ENTs (15.5 %) and others said they either prescribed just antibiotics or a sinus lift surgery (8.2 %). The treatment of odontogenic sinusitis often requires management of the sinusitis as well as the odontogenic origin. Though a specific global or gold standard management protocol is not yet established for the disease [30], Psillas *et al.* in a review in 2021 said once there is clear evidence of a dental infection source, our treatment should address the dental pathology first. This is because sometimes, dental infection removal alone is sufficient to resolve odontogenic maxillary sinusitis but some other times, concomitant sinusal surgical treatment (especially for foreign intrinsic bodies, that are represented by included teeth or by tooth roots displaced in the maxillary sinus) is necessary for full resolution. This means surgical treatment becomes an option only when OMS shows resistance to medical and dental treatment [37]. However, a study in the UK found that the most common management for OMS was synchronous ESS and dental surgery; that it ensured complete resolution of the infection and prevented recurrences and complications. Many authors supported this. However, Wang *et al.* reported that 33 % of their patients with successfully resolved OMS underwent sinus surgery alone; underlying that exclusive ESS could be an effective treatment approach [50]. Meanwhile, in 2018, the American Academy of Endodontics published a position statement on maxillary sinusitis of endodontic origin, suggesting that dental treatment should be performed first, followed by ESS only if needed. However, the management of a previously treated tooth, such as an endodontic-treated tooth (root canal-treated tooth) is challenging. As a result, extraction of the causative tooth of the OMS is usually performed. When the causative tooth is extracted, the inflammation chain between dental lesions and maxillary sinusitis will improve. However, other inflammation chains, such as retardation factors of sinusitis still exist. The worst situation for the

patient is that OMS is not cured even though the causative tooth has been extracted. This is why there is recent evidence to support the position of Wang *et al.* (that ESS alone may be an effective treatment approach to OMS). Craig *et al.* also support this suggestion (that ESS can be considered first-line therapy for symptomatic OMS), followed by dental treatment when necessary. According to this study, if the ventilation and drainage of the maxillary sinus is successfully restored after ESS, most of the causative teeth (endodontic treated teeth with periapical lesions) with minimal to absent symptoms can be preserved with antibiotic treatment alone. If the burden of OMS is high, primary ESS should be recommended, followed by close dental follow-up and dental treatment as needed [30]. These discrepancies sometimes depend on the grade of severity of both dental disease and sinusitis, as patients that have cured with dental surgery may have a lower sinonasal disease burden, whereas others suffering from minimal dental disease may completely recover after ESS alone. In any case, dental surgery should be the core component of management [51], and this was well demonstrated by Longhini and Ferguson, showing that 29 % of patients who had only undergone ESS failed to recover from OMS until dental surgery was performed [52].

V.3.3. Clinical diagnostic methods used in daily practice

Most of our participants used thorough dental and medical examination to diagnose OMS in their cabinets (97.9 %). This was good to know because the accurate diagnosis of OMS must begin with thorough medical and dental history. There is a statistic significance between participants who found it difficult to diagnose OMS and participants who did not pay attention to thorough clinical examination. Most dental surgeons who hurry with consultations are pruned to miss the diagnosis. Like earlier mentioned in the literature review, exact and accurate diagnosis of odontogenic origin is necessary to avoid the long-term administration of inappropriate medications or unnecessary surgical management [3].

V.3.4. Paraclinical assessment of odontogenic maxillary sinusitis

Most participants attested to prescribing panoramic radiographs as complementary exams for the diagnosis of OMS (68 %). 13.4 % said CT scans were their preferred complementary exams, 5.2 % picked CBCT, 5.1 % picked Blondeau position x-ray, 3.1 % preferred MRI and 5 % said they do not prescribe any complementary exams. Most recent literature posit that CBCT is the new gold standard complementary exams for OMS [25]. Unfortunately, because the technology is relatively new, it is not yet in use in Cameroon. This is why there is a statistic significance

between participants who studied abroad and choosing CBCT as a preferred diagnostic complementary exam.

V.3.5. OMS prevention methods

Out of the 97 dental surgeons who participated in our study, 89.7 % said they take precautions when treating posterior maxillary teeth or antral teeth. This means that 10.3 % of our participants approached the treatment of antral teeth like every other teeth (no special considerations). In most studies, iatrogenic factors are always ranked highest as risk factors of OMS [7, 11]. The treatment of posterior maxillary teeth must never be approached with a negligent attitude, because so many risks are involved. Their treatment requires a lot of cautiousness and attention. As already explained in the literature review, posterior maxillary teeth share a very close and sometimes complex anatomical relationship with the maxillary sinuses. Failure to apply caution while working on them greatly increases the chances of developing OMS. There are reports of cases where because of sheer carelessness, foreign bodies like cotton, gauze or instruments are forgotten in a tooth socket after an extraction. These can eventually move into the sinus (if the tooth concerned is an antral tooth) and cause sinus infection [52]. In order to avoid the introduction or penetration of foreign bodies into the maxillary sinus during surgery, Jerome and Hill recommend the use of gauze to block the maxillary sinus aperture [53].

Amongst the 89.7 % of dental surgeons who said they took precautions when treating antral teeth, 61.9 % knew and used the Valsalva maneuver after the extraction of an antral tooth to determine if there is oroantral communication but only 10.3 % said they use retroalveolar X-rays before commencing treatment procedures on antral teeth and for follow up. The use of retroalveolar X-rays before, during and after treatment procedures especially on antral teeth is emphasized by literature and should be taken serious by every dental practitioner. Working with retroalveolar X-rays will prevent costly blind decisions and increase the chances of treatment success. Out of the 73.2 % participants who said they gave relevant post-treatment counsels, for the prevention of sinus infection in a patient after the extraction of an antral tooth (tooth number 16), 89.7 % warned against smoking, 69.1 % warned against using a straw to drink and 77.3 % advised the patient to continue brushing, but gently, especially near the surgical area. Smoking or drinking using a straw after an extraction will interrupt blood clot formation, thereby prolonging healing time. This can lead to a dry socket and other complications. If a patient does not continue with good oral hygiene after an extraction, the socket may become infected and the

infection may perforate the sinus membrane, leading to a sinus infection [54]. Surprisingly, up to 8.2 % of our participants said they do not bother to give these basic but very necessary post extraction counsels.

Overall on attitudes and practices, 33.0 % of the participating dental surgeons had attitudes that fall within the average range, 4.1 % had good attitudes, 33.0 % had attitudes that fall within the insufficient range and 29.9 % had poor attitudes. For practices, 40.2 % of the participating dental surgeons had practices that fall within the average range, 29.9 % had practices that fall within the insufficient range, 25.8 % had poor practices and 4.1 % had good practices. This is in line with the percentages for knowledge and shows the relationship between the three variables. An average knowledge can only produce average attitudes and practices. To prevent OMS or improve the quality of care given to OMS patients, specialized trainings should be organized for practicing dental surgeons, the subject should be given serious attention in the dental curriculum of our medical faculties and more research work should be done so that the literature on the disease is properly documented.

V.10. Limitations of the research

Though our study was performed following an appropriate methodology and using very explicit and closed answer type questions, like every other research work, there were some few limitations. The first was the lack of previous research studies on the topic. This limited our access to data on this subject, especially in Cameroon. Due to constraints with time and resources, we were not able to involve every practicing dental surgeon in Yaoundé in our study. Therefore, our results may not be a perfect reflection of the knowledge, attitudes and practices of all dental surgeons in the city of Yaoundé.

CONCLUSION AND RECOMMENDATIONS

CONCLUSION

At the end of this study, which had as objective to assess the knowledge, attitudes and practices of dental surgeons in the management of odontogenic maxillary sinusitis, we drew the following conclusions:

- More than half (54.6 %) of our participants had an average knowledge on the management of odontogenic maxillary sinusitis, 33.0 % had insufficient knowledge, 13.4% had a poor knowledge and just 4.1 % of our total population had a good knowledge.
- For attitudes, 33.0 % of the participating dental surgeons had attitudes that fall within the average range, 33.0 % had attitudes that fall within the insufficient range, 29.9 % had poor attitudes and only 4.1 % had good attitudes.
- For practices, 40.2 % of the participating dental surgeons had practices that fall within the average range, 29.9 % had practices that fall within the insufficient range, 25. 8 % had poor practices and just 4.1 % of our total population had good practices.
- Very few of our participating dental surgeons (17.5 %) have received special training for OMS management and prevention. This is why iatrogenic factors are the leading causes of OMS.

Our results proved our research hypothesis, which stipulated that, dental surgeons have limited knowledge and exhibit mediocre attitudes and practices as regards the prevention and management of odontogenic maxillary sinusitis

RECOMMENDATIONS

To the Department of Bucco-dental Medicine

- Organize seminars and symposiums in order to sensitize dental practitioners on the preventive and management plan for OMS.

To dental surgeons

- Attend training seminars and symposiums on OMS management.
- Collaborate with ENT specialists to improve the quality of care given to this patient population.

To researchers

- So much research work still needs to be done on this subject, especially here in Cameroon; to bring awareness to the medical community of this underappreciated and frequently misdiagnosed disease. In the same line, to determine the best or gold standard approach to caring for this patient population, many prospective studies have to be carried out globally.

To the Faculty of Medicine and Biomedical Sciences

- There is a need for OMS to be given serious attention in the dental curriculum of our faculty**.** Our bucco-dental training section should adapt teaching modules that focus on OMS as a unique condition, instead of just mentioning it passively as a form of rhinosinusitis.

To the ministry of public health

- Encourage more research on this subject.
- Through the Cameroon Dental Association, reinforce continued dental education for practicing dental surgeons.
- Make the use of more modern imaging technology like CBCT possible in Cameroon, to facilitate and ease OMS diagnosis. CBCT has a higher resolution, lower cost, 10 % lower radiation dose when compared to the conventional CT scan and it's easier to tolerate for the patient due to shorter exam time and more comfortable sitting position.

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APPENDICES

APPENDIX 1: INFORMED CONSENT FORM

Theme: "Knowledge, attitudes and practices of dental surgeons in the management of patients with odontogenic maxillary sinusitis in the city of Yaoundé."

I, the undersigned, Dr.

…… Declare to have been duly informed and fully briefed by the Final Year Dental Medicine Student, NYINGCHUO BERTRAND NSOM, and have accepted to participate in the study in view of his M.D thesis. He clearly stated I was free to accept or deny the proposal. I have received and understood the information on the aim of the study, the possible constraints and risks.

I accept that all data collected with regards to me will be subject to a code of strict confidentiality. Only the research personnel and eventually a Health Authority representative will be given access to my data.

My participation can be interrupted at any time if the principal investigator sees necessary or if I wish without any prejudice. At any time, I can ask for supplementary information or make any corrections on my data.

I hereby accept to participate in the study under the set conditions.

Read and approved: YES NO

At Yaoundé, Date……. /……. /……..

Investigator's Signature Participant's Signature

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APPENDIX 2: QUESTIONNAIRE

THE UNIVERSITY OF YAOUNDE I

FACULTY OF MEDICINE AND BIOMEDICAL SCIENCES

Knowledge, attitudes and practices of dental surgeons in the management of patients with odontogenic maxillary sinusitis in the city of Yaoundé

QUESTIONNAIRE ADRESSED TO DENTAL SURGEONS

Date : ____/____/2023 Questionnaire number: _____ ONCDC number : _____

Please circle the correct answer(s)

Section 1.

Socio-demographic information.

1. Age (year): □ 20-40 □ 41-64 □ 65+
2. Gender: □ Male □ Female
3. Number of years in service: □ 1-5 □ 5-10 □ 10-15 □ 15-20 □ 20-25 □ 25-30 □ 30-35
4. Type of working place: □ Private □ Public
5. Domain of specialization:
   - □ General Dentistry
   - □ Pediatric Dentistry
   - □ Periodontology
   - □ Maxillofacial Surgery
   - □ Prosthetic Dentistry
   - □ Orthodontics
   - □ Endodontics
   - □ Others (specify):_____
6. Dental School:

□ FMBS Yaoundé □ UDM Bangangté

□ Others (specify):_____

Section 2.

Knowledge on odontogenic maxillary sinusitis.

7. Odontogenic maxillary sinusitis is a symptomatic inflammation of the maxillary sinus as a result of a dental pathology or dental procedures:

□ Yes

□ No

□ I do not know

8. The diagnosis of odontogenic maxillary sinusitis requires multidisciplinary collaboration between otolaryngologists and dental providers:

□ Yes

□ No

□ I do not know

9. On risk factors for odontogenic maxillary sinusitis:

a) Infection of posterior maxillary teeth is a possible risk factor for odontogenic maxillary sinusitis: □ Yes □ No

b) Infection of anterior maxillary teeth is a possible risk factor for odontogenic maxillary sinusitis: □ Yes □ No

c) Iatrogenic factors such as dental implants and complications of dental extractions constitute risk factors for odontogenic maxillary sinusitis: □ Yes □ No

d) Infection of anterior mandibular teeth is a high risk for odontogenic maxillary sinusitis: □ Yes □ No

e) Infection of posterior mandibular teeth is a high risk for odontogenic maxillary sinusitis: □ Yes □ No

10. The following can lead to OMS:

a) Oroantral fistulas: □ Yes □ No

b) Implant displacement into the sinus: □ Yes □ No

c) Migration of a tooth or root during dental extraction: □ Yes □ No

d) Endodontic treatment poorly done: □ Yes □ No

e) Dental caries: □ Yes □ No

f) Periapical infection: □ Yes □ No

g) Periodontal disease: □ Yes □ No

h) Odontogenic cysts: □ Yes □ No

11. Which of this tooth has the highest probability of causing OMS?

□ Maxillary first premolar

□ Maxillary second premolar

□ Maxillary first molar

□ Maxillary second molar

□ Maxillary third molar

□ Maxillary canine

□ None

12. Select the clinical signs of OMS:

a) Facial pain: □ Yes □ No

b) Foul odor: □ Yes □ No

c) Nasal congestion: □ Yes □ No

d) Purulent anterior rhinorrhea: □ Yes □ No

e) Tooth pain: □ Yes □ No

f) Postnasal dripping: □ Yes □ No

13. What are the possible complications of OMS:

a) Orbital cellulitis: □ Yes □ No

b) Cerebral abscesses: □ Yes □ No

c) Cavernous sinus thrombosis: □ Yes □ No

d) Meningitis: □ Yes □ No

e) None: □ Yes □ No

Knowledge on the management or treatment of patients with OMS in daily practice.

14. What are various treatment proposals for OMS:

a) Treatment of the dental infection: □ Yes □ No

b) Antibiotherapy: □ Yes □ No

c) Endoscopic Sinus Surgery: □ Yes □ No

d) Caldwell Luc Procedure: □ Yes □ No

e) None: □ Yes □ No

15. Which of these antibiotics will you recommend most for a case of OMS? □ Amoxicillin-clavulanate □ Doxycycline □ Ciprofloxacin □ Others (specify):_____

16. Which of these dental procedures can help in the management of OMS?

a) Extraction: □ Yes □ No

b) Endodontic treatment: □ Yes □ No

c) Apicoectomy: □ Yes □ No

Education and training in OMS management

17. Since you started working, have you undergone any special training in the management of OMS? □ Yes □ No

18. If yes, which type of training? □ Medical □ Surgical □ Radiological

□ Others (specify):_____

19. If no, do you think you need the training? □ Yes □ No

Section 3.

<u>Attitudes and practices towards patients with OMS.</u>

20. What are some of the barriers you have encountered as regards the treatment of OMS:

□ Inability to diagnose the disease

□ No proper education in the domain

□ Do not feel confident

□ Do not feel safe

□ No interest

□ Others (specify):_____

21. What is the average number of OMS cases you receive per month?

□ None □ 1 □ 2 □ 3 □ More than 3

22. Do you find it easy to diagnose sinusitis of dental origin in your daily practice?

□ Yes □ No

23. In your point of view, is it necessary to still refer cases of OMS to the ENT service when you have identified the odontogenic source and treated it? □ Yes □ No

24. Do you feel comfortable treating patients with OMS? □ Yes □ No

25. In your daily practice, do you take any precautions when treating posterior maxillary teeth or sinus-related teeth? □ Yes □ No

26. If yes, which precaution(s)?

a) Post-treatment counsels: □ Yes □ No

b) I pay careful attention to the correct administration of the treatment in view because of the risks involved: □ Yes □ No

c) I know the Valsalva maneuver and I use it after the extraction of antral teeth to determine if there is oro-antral communication: □ Yes □ No

d) I use retroalveolar X-rays before commencing treatment procedures on antral teeth and for follow up: □ Yes □ No

27. You just did a successful extraction of tooth number 16; which counsel(s) will you give your patient as preventive measures against sinus infection after the extraction?

a) Avoid the use of straws: □ Yes □ No

b) Rinse two times a day with a mouthwash: □ Yes □ No

c) Continue to brush your teeth, but gently, especially near the surgical area: □ Yes □ No

d) Do not smoke cigarettes: □ Yes □ No

e) Use decongestant medications: □ Yes □ No

f) None: □ Yes □ No

28. Which clinical method(s) do you usually use in this situation?

a) Experimenting using common sense: □ Yes □ No

b) Active listening (interviewing): □ Yes □ No

c) Thorough dental and medical/clinical examination: □ Yes □ No

d) Comprehensive history taking: □ Yes □ No

e) Others (specify):_____

29. Which imaging technique do you prescribe more frequently when you suspect OMS? □ Panoramic radiography □ CT scan □ CBCT □ MRI

□ Others (specify):_____

30. In your daily practice, which of these treatment methods have you used?

□ Dental treatment and antibiotherapy

□ Referred to ENT specialist

□ Dental treatment and referred to ENT specialist

□ Others (specify):_____

31. In your practice so far, have you treated any patient with OMS that was referred to your service by an ENT specialist? □ Yes □ No

APPENIDX 3: ETHICAL CLEARANCE

UNIVERSITÉ DE YAOUNDÉ I
FACULTÉ DE MÉDECINE ET DES SCIENCES BIOMÉDICALES
COMITÉ INSTITUTIONNEL D'ÉTHIQUE DE LA RECHERCHE
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THE UNIVERSITY OF YAOUNDE I
FACULTY OF MEDICINE AND BIOMEDICAL SCIENCES
INSTITUTIONAL ETHICAL REVIEW BOARD

Ref. : N° 0450 /UY1/FMSB/VDRC/DAASR/CSD

1 2 MAI 2023

CLAIRANCE ÉTHIQUE

Le COMITÉ INSTITUTIONNEL D'ÉTHIQUE DE LA RECHERCHE (CIER) de la FMSB a examiné

La demande de la clairance éthique soumise par :

M.Mme : NYINGCHUO Bertrand NSOM **Matricule: 16M185**

Travaillant sous la direction de :

- **Pr Ngaba Olive Nicole**
- **Dr Edouma Bohimbo Jacques Gérard**

Concernant le projet de recherche intitulé : **Knowledge, attitudes and practices of dental surgeons in the management of patients with odontogenic maxillary sinusitis in the city of Yaounde**

Les principales observations sont les suivantes

Evaluation scientifique	
Evaluation de la convenance institutionnelle/valeur sociale	
Equilibre des risques et des bénéfices	
Respect du consentement libre et éclairé	
Respect de la vie privée et des renseignements personnels (confidentialité) :	
Respect de la justice dans le choix des sujets	
Respect des personnes vulnérables :	
Réduction des inconvénients/optimalisation des avantages	
Gestion des compensations financières des sujets	
Gestion des conflits d'intérêt impliquant le chercheur	

Pour toutes ces raisons, le **CIER** émet un avis **favorable** sous réserve des modifications recommandées dans la grille d'évaluation scientifique.

L'équipe de recherche est responsable du respect du protocole approuvé et ne devra pas y apporter d'amendement sans avis favorable du **CIER**. Elle devra collaborer avec le **CIER** lorsque nécessaire, pour le suivi de la mise en œuvre dudit protocole.

La clairance éthique peut être retirée en cas de non - respect de la réglementation ou des recommandations sus évoquées.

En foi de quoi la présente clairance éthique est délivrée pour servir et valoir ce que de droit

LE PRESIDENT DU COMITE ETHIQUE