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Prevalence and localization of Maxillary Sinus Septa: a mini review

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Abstract. The anatomy of the maxillary sinus has been widely analysed over the last few years, specifically when it comes to its vascular anatomy, relationship to the teeth, and alveolar process. In fact, surgical procedures require the most accurate knowledge of anatomical structures, facilitated by the use of some state-of-the-art imaging technologies such as the cone beam computed tomography (CBCT). Such systems are constantly evolving in terms of quality, definition, image detail, and accuracy. This review aims to analyse the international literature of the last decade that has dealt with the topic of sinus anatomy, especially looking at the presence, percentage and localization of Underwood's septa, with the aim of supporting dentists to diagnose these anatomical structures in as much detail as possible and to perform surgery in this area with greater confidence.

Keywords: CBCT, maxillary sisus septa, oral surgery.

INTRODUCTION

The presence of adequate bone volume is crucial and represents a prerequisite for predictable results in implantology and implant prosthetics. Considering the upper jaw, large bone defects are rather treated with both autologous and/or non-autologous bone grafts but they are often associated with issues having different nature, such as the need for additional surgery, the limited availability of bone graft material, the short-time resorption, the inability to have intrinsic osteogenic (heterologous biomaterials) and the volumetric contraction of the material itself. Moreover, several anatomical complications are implicated in the upper jaw during sinus floor augmentation procedures. In fact, the presence of anatomical variants, such as the presence of one or more septa (as described by Underwood in 1910), also increases the risk of sinus membrane perforation during surgeries. Sinus septa are walls of cortical bone, located inside the sinus, whose shape has been described as an inverted Gothic arch arising from the sinus' lower or lateral walls and can even divide it into two or more cavities (Whyte A. et al, 2019;

Lorkiewicz-Muszynska D., 2015). Radiographic identification of these structures is extremely important since the design of the lateral hatch is based on the presence and size of the maxillary sinus septa, during sinus floor augmentation procedures (Von Arx et al, 2019). Therefore, the rapid progress made in recent years in dental radiology, specifically in cone beam computed tomography (CBCT), allowing for high detail and resolution images has been considered, also in light of the progressively frequent use of this technology made by dental specialists. Accordingly, this review aims to analyse the main articles published in the last decade on the presence, percentage, location, and average size of Underwood septa in the maxillary sinuses.

MATERIALS AND METHODS

Study design

Firstly, a Pubmed and Hand-Search were performed with the following keywords: "*maxillary sinus septa*", "*sinus anatomy*", "*maxillary sinus anatomy*", "*paranasal sinus septa*". These keywords were then combined with the Boolean operators 'AND', 'OR', 'NOT'. The following filters were applied: in the last 10 years, Meta-Analysis, Review, Systematic Reviews, and clinical trial. For what concerns the Hand-Search, references from the following journals were also consulted: Clinical Implant Dentistry, Journal of Periodontal and Implant Science, Clinical Oral Implants Research, Implant Dentistry. Therefore, the following inclusion criteria were considered: trials investigated using 3D radiographs that presented data on the prevalence and location of septa (primary outcome). The words "augmentation" and "elevation" were excluded, as well as all studies presenting secondary outcome data related to septa integrity, septa orientation, and septa diagnosis only by orthopantomography (OPT). Below is the flow chart (Figure 1) of the research:

RESULTS

Table 1 below summarises the results of the study. A total of 16 scientific papers were included (e.g., Books, Clinical Trials and Systematic Reviews) and analysed with respect to the number of sinuses studied, number of septa found, and respective percentages. Moreover, the most frequent location and the average size of septa were analysed as detailed in Table 1.

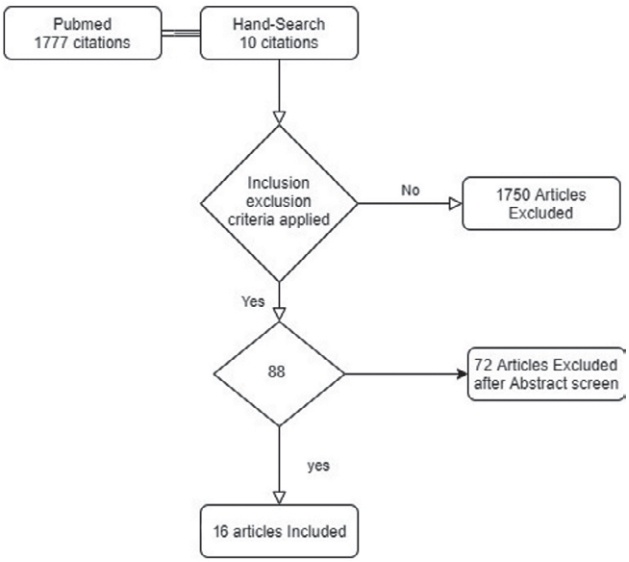

Figure 1. Flow-chart.

DISCUSSION

Sinus Floor Augmentation surgery can cause perforations of the membrane due to anatomical changes and septa.. Schneider's membrane perforation can lead to postoperative complications, including acute or chronic sinus infections with bacterial invasion, swelling, and bleeding. Dislodgement of biomaterial within the sinus membrane causing sinusitis, chronic or acute, may also occur. Careful radiographic assessment of the size and position of the septa prevents complications both during and after sinus floor augmentation surgery. Based on the findings of the present study, the prevalence of septa in maxillary sinuses ranges between 6% and 68.4%. Specifically, the percentage ranges between 22.93% and 68.4%, while the size varies from 3.6mm to 7.36mm, except for a case study carried out in 2019 (Anbiaee N. et al,2019). This wide variation could be attributed to the fact that single studies differ based on the radiographic methods used, the criteria for septa identification, and the samples. In particular, various radiographic methods such as panoramic radiography (OPT), computed tomography (CT), and CBCT have been used to assess the presence and the anatomy of sinus septa. However, the present review has excluded those studies assessing this by only means of orthopantomography, which has represented the gold standard in literature for several years. In fact, CBCT has now become the gold standard for identifying the presence of septa, since this facilitates a detailed assessment of the maxillary sinus anatomy. Some researchers define a septum as being more than 2.5 mm

Table 1.

Author	Year	CBCT/CT	N°=Sinus	N°=Septa	%	Localization	Size
Hungerbühler et al	2019	CBCT	602	188	31.2%	Anterior 56 (29.8%) **Middle 70(37.2%)** Posterior 62(33%)	N.A.
Zhang et al	2019	CBCT	N.A.	355	N.A.	Anterior 108 (30.4%) **Middle 180 (50.7%)** Posterior 67 (18.9%)	N.A.
Al-Zahrani et al	2020	CBCT	1010	370	45.9%	Anterior 23 (6.2%) **Middle 233(63%)** Posterior 114 (30.8)	6.06±0.84 Right 5.70±0.93 Left
Talo et al	2017	CBCT	1000	297	29.7%	Anterior 44(8.7%) Middle 123 (24.5%) **Posterior 131(26.4%)**	4.62±2.50 mm
Rancitelli et al	2015	CBCT	228	87	38.1%	Anterior (29.4%) **Middle (35.7%)** Posterior (34.7%)	5.5 mm ± 1.19
Kocac et al	2019	CBCT	500	287	47.6%.	Anterior 23.7% **Middle 57.49%** Posterior 18.81%	7.36mm
Qian L et al	2016	CBCT	1,012	390	48.2%	Anterior 136(34.8%) **Middle 160 (41%)** Posterior 94 (24.2%)	5.56 mm
Toraman Alkurt M et al	2016	CBCT	104	31	29.8%	Anterior 2(6.5%) **Middle 23(74.2%)** Posterior 6(19.35%)	N.A.
Taleghani et al	2017	CBCT	300	132	44%	Anterior (32.6%) **Middle (34.8%)** Posterior (32.6%)	3.6 ± 1.56 mm
Anbiaee N et al	2019	CT	199	23	6%	N.A.	N.A.
Khalighi Sigaroudi el al	2017	CBCT	444	265	68.4%	N.A.	N.A.
Velasco-Torres M et al	2017	CBCT	394	260	65.99%	N.A.	N.A.
Chitsazi MT et al	2017	CBCT	400	N.A.	26%	N.A.	N.A.
Orhan K et al	2013	CBCT	554	316	58%	Anterior 45 (12.2%) **Middle 254 (69.1%)** Posterior 70(18.6%)	5.12 mm
Shen EC et al	2012	CT	846	194	22.93%	Anterior 31 (15.98%) **Middle 105 (54.12%)** Posterior 53 (27.32%)	N.A.
Jang SY et al	2014	CBCT	200	63	26%	**Anterior (47.6%)** Middle (34.9%) Posterior (17.5%)	6.01 ± 2.21 mm

high, while for others, as in the case of Jang et al (Jang et al, 2014), a septum occurs when the bony walls are at least 4 mm. This is a key factor that should not be underestimated as this could justify the considerable discordance in the data found in the literature. When describing the location of the septa, it is usually referred to location in the anterior region when the septum is in a mesial position to the root of the second premolar, in the central

region when it is in a mesial position to the distobuccal root of the second molar and the distal root of the second premolar, and in the posterior region when it is in a distal position to the distobuccal root of the second molar. Also in this case, there is a broad debate about the prevalence of one area over another (Lovasova et al , 2018) . In fact, some studies have more frequently shown the presence of septa in the central region, while for others the most frequent location is indeed the anterior region, and finally, only for the study by Talo et all in 2017 (Talo et al,2017) and Khalighi Sigaroudi et al (Khalighi Sigaroudi et al, 2017) the posterior region resulted to be the most frequent one. However, in 10 out of the 16 articles analysed in the present study, septa were most frequently found in the middle region, consistently with most of the data in the literature. This is considered to be an interesting finding that should not be overlooked and certainly deserves further investigation. One of the limitations of the present study may rely in the fact that the division between edentulous and non-edentulous patients was not taken into account, with respect to localization. So, further studies could be carried out.

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