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Research Progress on Anatomical Structure of Alveolar Antral Artery

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Abstract

Alveolar antral artery is closely related to the bleeding of the maxillary sinus floor elevation. By reviewing the study of the alveolar antral artery, and analyzed the blood supply source, diameter, detection rate, relationship with bone wall and other characteristics of alveolar antral artery, so as to provide reference for avoiding alveolar antral artery injury in clinical practice.

Keywords: alveolar antral artery, maxillary sinus floor elevation, CBCT, maxillary sinus bleeding

1. Introduction

The maxillary sinus is a pyramid-shaped cavity located in the body of the maxilla on both sides. In general, the size of the maxillary sinus is asymmetrical on both sides, and its volume will increase with age or dentition defects. In implant surgery, sufficient bone height and bone density are important factors affecting the success of the surgery, and the loss of maxillary posterior teeth will lead to alveolar bone resorption, and even there is only a thin layer of cortical bone between the maxillary sinus and the oral cavity, which increases the difficulty of implant surgery requires internal and external maxillary sinus lifting to meet the bone requirements for implant implantation. In implant surgery and maxillary sinus lifting, the anatomical structure of the alveolar antral artery is often involved. Inadvertent injury can lead to intraoperative or postoperative bleeding, resulting in unclear surgical field of view, perforation of the maxillary sinus mucosa and other serious complications (Zhou Wenjuan & Liu Zhonghao, 2021). This article reviews the literature on the alveolar antral artery, hoping to provide reference for clinicians to reduce the risk of intraoperative or postoperative bleeding.

2. Blood Supply Source of Alveolar Antral Artery

The maxillary artery is located in the deep side of the face, and is one of the terminal branches of the external carotid artery. The posterior superior alveolar artery (PSAA) originates when the maxillary artery is about to enter the pterygopalatine fossa, and descends along the back of the maxillary body, giving off two branches, the gingival branch and the dental branch. Among them, the dental branch passes through the alveolar foramen and enters the alveolar canal, and is distributed in the maxillary molars, premolars and maxillary sinus mucosa. The infra orbital artery (IOA) gives off the superior alveolar anterior artery in the infraorbital canal, and supplies the maxillary anterior teeth, periodontal tissue and maxillary sinus mucosa through the alveolar canal to the alveolar process. Traxler et al found the source and route of the arterial blood supply through the dissection of the maxillary sinus (Traxler H et al., 1999). There are two anastomotic branches on the anterolateral wall of the bone (Rosano Gabriele et al., 2011), which are intraosseous anastomosis (IA) and extraosseous anastomosis (EA), which are shaped like an arch bridge. Among them, the intraosseous anastomotic branch is called “alveolar antral artery” (AAA) because of its close connection with the lateral wall of the maxillary sinus. It was first discovered and described by Strong (1934) in 1934.

3. Detection Rate of Alveolar Antral Artery

The detection rate of alveolar antral artery in the lateral sinus wall at autopsy is 100% (Kqiku Lumnije et al., 2013; Starch-Jensen T et al., 2018), but the detection rate based on CT and CBCT is not the same. L. Khojastehpour and his team detected the alveolar antral artery in 80.6% of CBCT images (L. Khojastehpour et al., 2016), similar to the findings of Ilguy et al. (2013) (80.3%). But lower than the research results of Anamali et al. (2015) (90.9%). Kim Jee Hwan et al. (2011) reported that the detection rate of maxillary sinus arteries in preoperative CT examination was 52%. Similar to the research results of Rysz et al. (2014) (50%), slightly lower than the research results of Watanabe and his team (2014) (58.6%). Some scholars conducted a systematic review and meta-analysis by comparing a number of imaging studies. The results of the study showed that the total detection rate of the alveolar antral artery was 62.02%. The frequency of detecting the alveolar antral artery in the CBCT study was 61.25% – 94.98%, which was higher than the 42.33% – 60.05% in the CT study.(P. Varela-Centelles et al., 2015). These results suggest that compared with conventional CT, preoperative CBCT assessment can detect maxillary sinus arteries more effectively, and CBCT also has the advantages of small size and low radiation dose.

4. Diameter of Alveolar Antral Artery

According to literature statistics, the average diameter of the alveolar antral artery is 0.85-1.5 mm (Valente Nicola Alberto, 2016), and there is no significant difference in the diameter of the arteries on both sides. The arterial diameter is influenced by many factors. Studies have shown that the diameter of the alveolar antral artery is related to gender, and the vessels in men are significantly larger than those in women (Varela Centelles P et al., 2016; Kang S J et al., 2013); as the thickness of the lateral wall of the maxillary sinus increases, the diameter of the vessels also increases (Varela-Centelles P et al., 2015). The larger the diameter of the alveolar antral artery in the patient's bone, the greater the chance of interference, and the results of the study showed that the risk of interference with the larger diameter alveolar antral artery was minimal when surgery was performed in the second molar area. Therefore, preoperative evaluation of the thickness of the side wall of the maxillary sinus and special attention to this artery can reduce intraoperative complications (Liu Chenghui et al., 2018; Amin Rahpeyma et al., 2014); P. V arela-Centelles' study using a flexible model found that the width of the maxillary sinus and the diameter of the alveolar antral artery were between There is a correlation between 7-14mm, the wider the maxillary sinus, the more likely to find a large alveolar antral artery (Varela Centelles P et al., 2016); the greater the height of the remaining alveolar ridge, the larger the diameter of the alveolar antral artery (Varela-Centelles P, Loira M, González-Mosquera A, et al., 2020); Four different measurement results from the first premolar to the second molar showed that the diameter of the alveolar antral artery decreased slightly when it advanced from the origin to the premolar area (Watanabe Takeshi et al., 2014); Wang Xiaodong et al. (2023) found that the arterial diameter was larger in patients aged 56-87. The study by Dilhan Ilgüy et al. (2013) also found that the arterial diameter was larger in older patients, similar to the results of the study by Mardinger et al. (2007). However, LAOVORAVIT et al., VARELA-CENTELLES et al. believed that there was no significant correlation between the diameter and age (Laovoravit V et al., 2021; Varela-Centelles P et al., 2020). The reason why the diameter of the alveolar antral artery increases with age may be that the artery can be highly compressed in osteoporotic bones. Detected that the elderly are prone to osteoporosis, so this artery is more likely to be marked and will be more obvious in the image (Ding Wen-Ge et al., 2012; Buettmann Evan G et al., 2022); LAOVORAVIT believes that the alveolar antral artery diameter has no correlation with the condition of the teeth (Laovoravit V, Kretapirom K, & Pornprasertsuk-Damrongsri S., 2021), but Dilhan Ilgüy et al. (2013) believed that the arterial diameter was positively correlated with the number of edentulous patients, which may be due to the increased bone resorption after edentulous patients. The diameter of the alveolar antral artery is very important for surgical planning and risk assessment. If the diameter is large or similar to other anatomical structures, more care should be taken during surgery to avoid damaging the artery.

5. Relationship Between Alveolar Antral Artery and Bone Wall

The maxillary sinus arteries maintain a different relationship to the sinus wall. Usually completely intraosseous and rarely subperiosteal on the lateral wall (P. Varela-Centelles et al., 2015). CBCT studies have shown that the alveolar antral artery is located in the bone in 47%-73% of cases, in the submucosa in 22%-47% of the cases, and in the outer cortex or superficial position in 5%-6% of the cases (Iwanaga Joe et al., 2019). Ilgüy et al. reported that the maxillary sinus arteries occurred in 71.1% of cases intraosseously, 13% occurred below the sinus membrane, and 5.2% occurred in the outer cortex of the lateral sinus wall (Dilhan Ilgüy et al., 2013). Based on CBCT, Chen Deping's team divided the alveolar antral artery into four types according to the relationship between the position of the fenestration on the side wall of the maxillary sinus and the bone wall: intraosseous type (located in the cortical bone of the lateral wall of the maxillary sinus), and partial intraosseous type. (located in the subperiosteal groove facing the maxillary sinus cavity), extraosseous type (located between the lateral wall of the maxillary sinus and the permucosal membrane), mixed type (Chen Deping et al., 2022). Among them, the

incidence rate of intraosseous type was 64.3%, that of partial intraosseous type was 29.1%, and that of exoskeletal type was 6.6% (Zhou Wenjuan & Liu Zhonghao, 2021). Inconsistent with the above results, Jung et al. showed that 23.6% of the maxillary sinus arteries occurred in the bone, 52.8% occurred in the sinus, and 6.4% occurred in the superficial surface (Jung Junho et al., 2011). This may be due to the fact that some anastomotic branches in the bone are too small to be reflected on CBCT.

6. The Course of the Alveolar Antral Artery

The course of the maxillary sinus arteries in the anterolateral wall of the maxillary sinus is not uniform. Its distance from the alveolar crest and maxillary sinus floor is variable. The study found that the distance from the alveolar antral artery to the alveolar crest is related to the position of the positioned tooth. After dissecting 20 maxillary specimens and measuring and analyzing them, Lumnije Kqiku et al. concluded that the average distance from the intraosseous anastomosis of the maxillary second molar to the alveolar crest was 17.7 mm, that of the first molar was 14.5 mm, and that of the second premolar was 14.66 mm. The average distance from the lower border of the alveolar antral artery to the alveolar crest was 14.66-17.72 mm (Lumnije Kqiku et al., 2013). Seung-Min Yang et al. analyzed 283 samples. The average distance from the alveolar crest to the lower border of the alveolar antral artery was 19.6±5.64 mm at the first premolar, 19.9±5.87 mm at the second premolar, and 19.9±5.87 mm at the first premolar. The molars were 15.6±4.06 mm, and the second molars were 16.5±4.75 mm (Yang Seung-Min & Kye Seung-Beom, 2014). These data are different in edentulous patients. Lumnije Kqiku et al. investigated the distance from the alveolar antral artery to the alveolar crest in edentulous specimens, which was 17 mm to the maxillary second molar, 13 mm to the maxillary first molar, and 13 mm to the maxillary first molar. The second premolar is 14mm. The average distance from the alveolar ridge to the alveolar antral artery is 13–17 mm (Kqiku Lumnije, Biblekaj Robert & Weiglein Andreas H., 2016). There is a certain difference in this value, which may be due to differences in gender, age, remaining teeth in the mouth, alveolar bone absorption, and measurement errors. According to the above data, it can be concluded that the alveolar antral artery-alveolar ridge distance presents a decreasing trend from the second molar area to the first molar area, usually reaches a lower peak value in the first molar area, and then suddenly increases and reaches a relatively low peak. high peak.

The average distance from the alveolar antral artery to the maxillary sinus floor is 5.8-10.4 mm, and the shortest is 0 mm (Alberto N V., 2016). With the loss of teeth, the alveolar ridge shrinks, and the distance from the alveolar antral artery to the maxillary sinus floor also changes. Some studies have described the relationship between the position of the alveolar antral artery and the height of the remaining alveolar bone. Seung-Min Yang et al. found that the higher the residual bone ridge, the shorter the distance from the maxillary sinus floor to the endosseous anastomosis (Yang Seung-Min & Kye Seung-Beom, 2014). According to the research, it was found that the distance from the alveolar antral artery to the sinus floor was not significantly affected by gender, age, and dentition status (Wang Xiaodong et al., 2023; Karslioglu H et al., 2021). This suggests that the alveolar antral artery is more stable relative to the anatomical reference of the maxillary sinus floor than the alveolar crest.

7. Alveolar Antral Artery Bleeding and Related Treatment

The alveolar antral artery supplies the anterolateral wall of the maxillary sinus and Schneider’s membrane. Hemorrhage resulting from injury to the alveolar antral artery during sinus elevation is referred to as maxillary sinus hemorrhage (Zhou Wenjuan & Liu Zhonghao, 2021). The incidence of bleeding during maxillary sinus floor lifting was 6.28%, and the bleeding rate during external lifting accounted for 87% of the total bleeding rate (Wang Guanglei & Lei Lang, 2018). Intraoperative and postoperative bleeding is a serious complication of maxillary sinus floor lift (Gao Wenmo, Geng Wei & Chen Ming, 2021). Although the rupture of this type of artery is not life-threatening, and most of the bleeding resolves spontaneously due to reactive contraction, it is possible that the visibility of the Schneider’s membrane may be impaired, causing accidental perforation of the Schneider’s membrane and interfering with the placement of bone graft material, making surgery difficult, increasing the risk of surgical failure. Especially when the diameter is large, it will cause blood vessels to bleed continuously, causing the patient’s physical and mental discomfort. When the diameter of the blood vessel is less than 1mm, the risk of bleeding is negligible (Timmenga N M et al., 2003); when the diameter is 1-2mm, the risk of bleeding during surgery is about 57% (Cawood J. I. & Howell R. A., 1988); when the diameter is greater than 2mm, the risk of bleeding increases significantly (Rodella L F et al., 2010). Prophylactic ligation of the bone window before the preparation of the bone window and avoiding the blood vessel during the preparation of the bone window can reduce the risk of bleeding (Tavelli Lorenzo et al., 2017; Maridati Paolo et al., 2014).

Regarding the management of alveolar antral artery hemorrhage, Flanagan et al suggested occluding the canal by placing a fine-grained bone graft together with a graft carrier and gently pressing into place, or using electrocautery to stop bleeding (Flanagan Dennis, 2005), but if electrocautery occurs near the Schneider’s membrane, which may cause necrosis of the membrane and thus affect the coverage of the graft (van den Bergh

J P et al., 2000). In addition, sterile gauze dipped in saline can be used for hemostasis. In 2021, our country put forward an expert consensus on the complications of maxillary sinus floor lifting surgery (Zhou Wenjuan & Liu Zhonghao, 2021). The article pointed out that when performing maxillary sinus floor lifting surgery, careful evaluation and planning should be performed before surgery, and the anatomy and distribution of maxillary sinus arteries should be mastered, and be prepared to deal with bleeding; the operation should be performed with caution, and an ultrasonic osteotome can be used to carefully peel off the bone wall and periosteum. If bleeding occurs, methods such as local compression, ligation, electrocautery, laser hemostasis, or the use of hemostatic agents can be performed; postoperative anti-infective treatment should be carried out and follow-up should be strengthened.

To sum up, the anatomical structure of the alveolar antral artery is relatively complex, and once bleeding can easily affect the operation process. With the advancement of science and technology, CBCT has gradually been widely used in clinical practice, and has the advantages of small radiation dose, high resolution, and relatively economical price. Therefore, for cases of maxillary sinus elevation, it is recommended to take CBCT before operation to accurately grasp the course and distribution of blood vessels in the maxillary sinus floor elevation area. Preoperative CBCT examination to understand the course and distribution of the artery can make the surgeon more alert to the possible bleeding risk during the operation. For blood vessels with larger diameters, in order to avoid damage to the alveolar antral artery, the position of the bone incision or side wall fenestration can be changed or prophylactic ligation can be performed to prevent bleeding. In addition, detailed preoperative examination and consultation are also very necessary. Those with bleeding disorders and taking anticoagulants should be treated accordingly or consulted with relevant departments.

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References

Alberto N V., (2016). Anatomical Considerations on the Alveolar Antral Artery as Related to the Sinus Augmentation Surgical Procedure. *Clinical implant dentistry and related research, 18*(5).

Amin Rahpeyma and Saeedeh Khajehahmadi and Parvin Amini, (2014). Alveolar Antral Artery: Does its Diameter Correlate with Maxillary lateral wall Thickness in Dentate Patients? *Iranian Journal of Otorhinolaryngology, 26*(3), 163-167.

Anamali S, Avila-Ortiz G, Elangovan S, et al., (2015). Prevalence of the posterior superior alveolar canal in cone beam computed tomography scans. *Clin Oral Implants Res., 26*(1), e8-e12.

Buettmann Evan G et al., (2022). Similarities Between Disuse and Age-Induced Bone Loss. *Journal of Bone and Mineral Research: The Official Journal of the American Society for Bone and Mineral Research, 37*(8), 1417-1434.

Cawood J. I. and Howell R. A. (1988). A classification of the edentulous jaws. *International Journal of Oral and Maxillofacial Surgery, 17*(4), 232-236.

Chen Deping, Liu Qian, Pi Xuemin, Pan Hong, Tan Baosheng, Su Yucheng, (2022). Applied anatomy and CBCT evaluation of maxillary sinus blood supply and mucoperiosteum. *Chinese Journal of Oral Implantology, 27*(04), 259-263.

Dilhan Ilgüy, Mehmet Ilgüy, Semanur Dolekoglu, Erdogan Fisekcioglu, (2013). Evaluation of the posterior superior alveolar artery and the maxillary sinus with CBCT. *Brazilian Oral Research, 27*(5), 431-7.

Dilhan Ilgüy, Mehmet Ilgüy, Semanur Dolekoglu, Erdogan Fisekcioglu, (2013). Evaluation of the posterior superior alveolar artery and the maxillary sinus with CBCT. *Brazilian Oral Research, 27*(5).

Ding Wen-Ge et al., (2012). Difference in intraosseous blood vessel volume and number in osteoporotic model mice induced by spinal cord injury and sciatic nerve resection. *Journal of bone and mineral metabolism, 30*(4), 400-7.

Flanagan Dennis, (2005). Arterial supply of maxillary sinus and potential for bleeding complication during lateral approach sinus elevation. *Implant dentistry, 14*(4), 336-8.

Gao Wenmo, Geng Wei, Chen Ming, (2021). Consideration of local factors related to maxillary sinus floor lifting. *Chinese Journal of Oral Implantology, 26*(01), 67-71.

Iwanaga Joe et al., (2019). Clinical anatomy of the maxillary sinus: application to sinus floor augmentation. *Anatomy & cell biology, 52*(1), 17-24.

Jung Junho et al., (2011). A radiographic study of the position and prevalence of the maxillary arterial

endosseous anastomosis using cone beam computed tomography. *The International journal of oral & maxillofacial implants, 26*(6), 1273-8.

Kang S J, Shin S I, Herr Y, Kwon Y H, Kim G T, Chung J H., (2013). Anatomical structures in the maxillary sinus related to lateral sinus elevation: a cone beam computed tomographic analysis. *Clin Oral Implants Res., 24*(A100), 75-81.

Karslioglu H, Çitir M, Gunduz K, Kasap P., (2021). The Radiological Evaluation of Posterior Superior Alveolar Artery by Using CBCT. *Curr Med Imaging., 17*(3), 384-389.

Kim Jee Hwan et al., (2011). A radiographic study of the posterior superior alveolar artery. *Implant dentistry, 20*(4), 306-10.

Kqiku Lumnije and Biblekaj Robert and Weiglein Andreas H., (2016). Location of the extraosseous and intraosseous arterial anastomosis of the maxillary sinus in edentulous specimens. *Clinical oral investigations, 20*(8), 2311-2314.

Kqiku Lumnije et al., (2013). Arterial blood architecture of the maxillary sinus in dentate specimens. *Croatian medical journal, 54*(2), 180-4.

L. Khojastehpour et al., (2016). Evaluating the anatomical location of the posterior superior alveolar artery in cone beam computed tomography images. *International Journal of Oral & Maxillofacial Surgery, 45*(3), 354-358.

Laovoravit V, Kretapirom K, Pornprasertsuk-Damrongsri S., (2021). Prevalence and morphometric analysis of the alveolar antral artery in a group of Thai population by cone beam computed tomography. *Oral Radiol., 37*(3), 452-462.

Liu Chenghui, Zhang Xuemei, Ying Yiqian, Ma Pan, (2018). CBCT study of the bone foramen of the alveolar maxillary sinus artery. *Beijing Journal of Stomatology, 26*(03), 146-149.

Lumnije Kqiku et al., (2013). Arterial blood architecture of the maxillary sinus in dentate specimens. *Croatian Medical Journal, 54*(2).

Maridati Paolo et al., (2014). Alveolar antral artery isolation during sinus lift procedure with the double window technique. *The open dentistry journal, 8*(1), 95-103.

O. Mardinger et al., (2007). Prevalence, diameter and course of the maxillary intraosseous vascular canal with relation to sinus augmentation procedure: a radiographic study. *International Journal of Oral & Maxillofacial Surgery, 36*(8), 735-738.

P. Varela-Centelles et al., (2015). Detection of the posterior superior alveolar artery in the lateral sinus wall using computed tomography/cone beam computed tomography: a prevalence meta-analysis study and systematic review. *International Journal of Oral & Maxillofacial Surgery, 44*(11), 1405-1410.

Rodella L F et al., (2010). Intraosseous anastomosis in the maxillary sinus. *Minerva stomatologica, 59*(6), 349-54.

Rosano Gabriele et al., (2011). Maxillary sinus vascular anatomy and its relation to sinus lift surgery. *Clinical oral implants research, 22*(7), 711-715.

Rysz M, Ciszek B, Rogowska M, Krajewski R., (2014). Arteries of the anterior wall of the maxilla in sinus lift surgery. *Int J Oral Maxillofac Surg., 43*(9), 1127-1130.

Starch-Jensen T, Aludden H, Hallman M, Dahlin C, Christensen AE, Mordenfeld A., (2018). A systematic review and meta-analysis of long-term studies (five or more years) assessing maxillary sinus floor augmentation. *Int J Oral Maxillofac Surg., 47*(1), 103-116.

Strong C., (1934). The Innervation and Vascular Supply of the Antrum: (Section of Laryngology). *Proceedings of the Royal Society of Medicine, 27*(6), 745-751.

Tavelli Lorenzo et al., (2017). Sinus presurgical evaluation: a literature review and a new classification proposal. *Minerva stomatologica, 66*(3), 115-131.

Timmenga N M, Raghoebar G M, Liem R S, van Weissenbruch R, Manson WL, Vissink A., (2003). Effects of maxillary sinus floor elevation surgery on maxillary sinus physiology. *Eur J Oral Sci., 111*(3), 189-197.

Traxler H et al., (1999). Arterial blood supply of the maxillary sinus. *Clinical anatomy, 12*(6), 417-21.

Valente Nicola Alberto, (2016). Anatomical Considerations on the Alveolar Antral Artery as Related to the Sinus Augmentation Surgical Procedure. *Clinical implant dentistry and related research, 18*(5), 1042-1050.

van den Bergh J P et al., (2000). Anatomical aspects of sinus floor elevations. *Clinical oral implants research, 11*(3), 256-65.

Varela Centelles P et al., (2016). Diameter of alveolar antral artery in the lateral sinus wall: study of related factors. *The British journal of oral & maxillofacial surgery, 55*(4), 413-415.

Varela Centelles P et al., (2016). Diameter of alveolar antral artery in the lateral sinus wall: Study of related factors. *The British journal of oral & maxillofacial surgery*.

Varela-Centelles P, Loira M, González-Mosquera A, et al., (2020). Study of factors influencing preoperative detection of alveolar antral artery by CBCT in sinus floor elevation. *Sci Rep., 10*(1), 10820. Published 2020 Jul 2.

Varela-Centelles P, Loira M, González-Mosquera A, et al., (2020). Study of factors influencing preoperative detection of alveolar antral artery by CBCT in sinus floor elevation. *Sci Rep., 10*(1), 10820. Published 2020 Jul 2.

Varela-Centelles P, Loira-Gago M, Seoane-Romero J M, Takkouche B, Monteiro L, Seoane J., (2015). Detection of the posterior superior alveolar artery in the lateral sinus wall using computed tomography/cone beam computed tomography: a prevalence meta-analysis study and systematic review. *Int J Oral Maxillofac Surg., 44*(11), 1405-1410.

Wang Guanglei, Lei Lang, (2018). Analysis of complications and influencing factors during maxillary sinus floor lift. *Chinese Journal of Practical Stomatology, 11*(08), 486-490. DOI:10.19538/j.kq.2018.08.010.

Wang Xiaodong, Meng Lingjiao, Sun Hui, Chen Zhifang, (2023). Imaging study of maxillary sinus artery foramen in maxillary first molars region based on CBCT. *Chongqing Medicine, 52*(06), 849-854.

Watanabe T, Shiota M, Gao S, Imakita C, Tachikawa N, Kasugai S., (2014). Verification of posterior superior alveolar artery distribution in lateral wall of maxillary sinus by location and defect pattern. *Quintessence Int., 45*(8), 673-678.

Watanabe Takeshi et al., (2014). Verification of posterior superior alveolar artery distribution in lateral wall of maxillary sinus by location and defect pattern. *Quintessence international, 45*(8), 673-8, Berlin, Germany: 1985.

Yang Seung-Min and Kye Seung-Beom, (2014). Location of maxillary intraosseous vascular anastomosis based on the tooth position and height of the residual alveolar bone: computed tomographic analysis. *Journal of periodontal & implant science, 44*(2), 50-6.

Yang Seung-Min and Kye Seung-Beom, (2014). Location of maxillary intraosseous vascular anastomosis based on the tooth position and height of the residual alveolar bone: computed tomographic analysis. *Journal of periodontal & implant science, 44*(2), 50-6.

Zhou Wenjuan, Liu Zhonghao, (2021). Expert consensus on complications of maxillary sinus floor lifting: bleeding (first edition). *Chinese Journal of Oral Implantology, 26*(06), 345-348.