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CBCT观测上颌窦解剖结构的研究进展

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摘 要

上颌窦提升术作为上颌后牙区垂直骨量不足的解决方案被应用于临床中，为降低窦底黏膜穿孔、出血、上颌窦炎等并发症的发生率，需要在术前对上颌窦相关的解剖结构进行放射学检查。锥体束计算机断层扫描技术(cone-beam computed tomography, CBCT)对于上颌窦能够起到很好的显像作用，在临床中得到广泛的运用。本文就上颌窦术前应用CBCT观测上颌窦局部解剖结构的研究现状进行综述。

关键词

CBCT，上颌窦解剖，上颌窦提升术

Research Progress of Anatomical Structure of Maxillary Sinus Observed by CBCT

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Abstract

Maxillary sinus lift has been applied in clinical practice as a solution for vertical bone insufficiency in the maxillary posterior region. In order to reduce the incidence of sinus mucosa perforation, bleeding, maxillary sinusitis and other complications, it is necessary to conduct radiological ex-

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amination of the related structures of maxillary sinus before surgery. Cone-beam computed tomography (CBCT) can play a good role in the imaging of maxillary sinus and has been widely used in clinical practice. In this paper, the current status of the study on the local anatomical structure of maxillary sinus observed by CBCT before maxillary sinus surgery was reviewed.

Keywords

CBCT, Anatomy of Maxillary Sinus, Maxillary Sinus Augmentation

1. 引言

1997 年，Arial 和同事发明了第一代 CBCT [1]技术。在随后两年里，该技术被应用于大约 2000 例牙齿及颌骨疾病手术前后的放射学评估中，结果证明它是可行的[2]。相较于传统 CT，CBCT 具有体积小、成本低、辐射少的优点，使得该技术在口腔科的临床应用中得到进一步发展。

种植修复上颌后牙区的缺失，往往伴随剩余骨高度不足的问题[3]，上颌窦提升术为这一类患者提供了治疗条件，同时，也存在一些并发症[4]。为了尽量减少术中和术后并发症的发生率，必须对患者进行全面的术前病史采集，以及详实的临床和影像学评估。CBCT 已被证实是一种能够直观观测上颌窦三维解剖形态的工具[5]，并在临床得到广泛的运用。本文就 CBCT 观测上颌窦局部解剖特点的相关研究进行综述。

2. 上颌窦气化

上颌窦气化是指上颌窦窦腔伴随生长发育，由出生时的被液体到逐渐被气体充满一个生理过程。其气化过程，呈膨胀性向四周进行，与上颌后牙区种植密切相关的是上颌窦向牙槽突方向的气化。

上颌窦气化后的窦底形态，可分为平坦型、凹面型、凸面型[6]。刘锦峰等[7]将上颌窦向牙槽突气化分为三型：I 型(正常气化)，上颌窦底部高于或等于硬腭的口腔面，上颌窦底壁是接近水平的；处于 II 型(显著气化)及 III 型(过度气化)时，上颌窦底部低于硬腭的口腔面，牙根未进入上颌窦底部为 II 型，否则为 III 型。NIU 等将上颌窦底形态分为 A (窄锥形)、B (锥形)、C (卵形)、D (方形)、E (不规则) 5 型，并根据不同的窦底形态，提供与其相对应的上颌窦提升术式的选择[8]。

上颌窦过度气化会导致上颌后牙区的牙槽骨剩余骨量不足[9]，术前 CBCT 观测上颌窦形态对上颌后牙区种植术式的方案选择具有指导意义。

3. 上颌窦黏膜

上颌窦黏膜，又称施耐德膜(Schneiderian membrane)、上颌窦黏骨膜，是上颌窦内壁上附着的黏膜组织，对大体进行测量显示其组织学平均厚度为(0.30 ± 0.17) mm，CBCT 测量上颌窦黏膜的厚度约为组织学厚度的 2.6 倍，二者具有显著性差异[10]，由于组织学厚度的不可获得性，临床上通常以影像学厚度作为参考。

目前认为，上颌窦黏膜过薄或者过厚在上颌窦提升术中都易出现上颌窦黏膜穿孔的并发症[11]，且上

颌窦黏膜的增厚还可能致使上颌窦窦口阻塞，上颌窦内部液体难以排出，从而增加鼻窦炎症的发生概率[12]。上颌窦黏膜病理性增厚与鼻窦炎症、颌骨囊肿、根尖囊肿相关[13]，也可能是由创伤、化学物质、异物反应、肿瘤或气道条件所致，同时牙龈生物型、牙周病、吸烟、季节变化等因素也会影响鼻窦黏膜厚度[14]。

对于施耐德膜厚度的研究，有学者认为施耐德膜大于 2 mm 为病理性增厚[15] [16]，Maska 等认为这个值为 1 mm [17]，还有学者认为大于 3 mm 或者大于 5 mm 可界定为病理性增厚[18] [19]。目前，不同学者对上颌窦黏膜病理性增厚的阈值还存在争议。临床上有病例显示，对施耐德膜厚度 15 mm 且无症状患者行上颌窦内提升同期植入种植体，患者预后良好[13]；有研究结果显示上颌窦黏膜无症状增厚 2~5 mm 组与正常组相比，上颌窦提升术后骨形成及黏膜增厚变化无显著性差异[20]。可见上颌窦黏膜增厚并非上颌窦提升术禁忌症，临床上还需结合患者病史、体征来评估手术可行性。

4. 上颌窦骨分隔

上颌窦骨分隔，或称上颌窦间隔，为上颌窦内最常见的解剖变异之一[21]，其存在与上颌窦黏膜穿孔的发生有着密切关系[22] [23]。上颌窦骨分隔的发生率，不同学者对其的研究结果差异较大。Lana 等以人数为对象进行研究，其发生率为 44.4% [24]，Naitoh 等以上颌窦数为对象进行研究，其发生率为 37% [25]，褚杨等以上颌窦数和人数为对象得到的结果分别为 21.6%和 28.8% [26]，总体而言，其人群患病率在约 28%~58%之间[26] [27] [28]。

上颌窦骨分隔因分布、高度的不同呈现不同类型。孔伟等根据骨分隔方向将其分为垂直冠状骨分隔、垂直矢状骨分隔、斜型骨分隔、水平骨分隔[29]，研究发现垂直矢状骨分隔占比较大[26] [29]。上颌窦间隔在不同部位的发生率不同，Orhan 等将上颌窦分为前、中、后三部分，上颌窦中部为间隔常见发生部位[30]；根据发生的牙位来区分，以第一磨牙和第二磨牙最为常见[31]。

上颌窦骨分隔可分为原发性骨分隔和继发性骨分隔[32]。最早发现上颌窦骨分隔的 Underwood 认为，原发性骨分隔为颌骨发育时由于牙齿萌出，牙齿之间骨板沉积形成的分隔，而他发现另一种骨分隔产生原因则不相同[33]。Krennmair 等将上颌窦骨分隔分为原发性骨分隔和继发性骨分隔，原发性骨分隔与 Underwood 描述的相同，他认为继发型骨分隔是由于牙齿脱落后上颌窦底不规则气化导致的[34]。有研究对 200 个上颌窦进行 CT 观测发现上颌后牙缺失窦间隔发生率(31.76%)高于完整牙列窦间隔发生率(22.61%)，该差异具有统计学意义[35]，提示牙齿缺失对上颌窦间隔发生的具有一定影响作用，佐证了 Krennmair 的观点。目前认为，上颌窦骨分隔如果位于上颌牙上方，则被归类于原发性骨分隔；位于无牙颌上方的骨分隔，可被认定为继发性或者原发性，也可以是两者结合[36]。对于继发性窦间隔的界定，目前不同学者的看法还存在一定争议，仍需进一步的研究。临床上，对于上颌窦提升影响较大的是垂直向骨分隔，尤其是位于缺牙区的骨分隔，需要医生进行术前影像排查以进一步选择治疗方案。

5. 上颌窦口

上颌窦口位于上颌窦内侧壁的上侧面，与中鼻道相通，窦口的大小在 3 到 10 毫米之间[37]，起到引流上颌窦内液体的作用。近年来有研究表明上颌窦口解剖结构与上颌窦黏膜增厚具有一定的相关性，白洋等对 200 例上颌窦窦口直径、鼻中隔偏曲、剩余牙槽嵴高度以及上颌窦黏膜厚度进行 CBCT 测量，得出前三者均与上颌窦黏膜呈负相关，该结果具有统计学意义[38]。

上颌窦口阻塞可能是上颌窦提升术后出现上颌窦炎的原因之一[39]。其影响机制可能为上颌窦术后易引起黏膜水肿，当肿胀范围波及上颌窦口，会导致窦口阻塞，以进一步加剧上颌窦炎的发生。

综上，上颌窦炎症与窦口的阻塞呈协同作用，为减少术后出现严重并发症的概率，术前进行 CBCT

排查上颌窦口解剖有无异常具有较好的临床应用意义。

6. 上颌窦侧壁

上颌窦侧壁即上颌窦外侧骨壁，骨壁的厚度越厚，上颌窦外提升的手术难度越大，相应窦黏膜穿孔等并发症的发生率也随之增加[40]。Basma 等对 209 例 CBCT 影像进行观测，结果显示穿孔组的冠状面至窦底 4 mm 和 6 mm 处平均壁厚大于非穿孔组的厚度，该差异具有统计学意义[41]。

上颌窦骨壁平均厚度为 1.95 ± 0.98 mm [42]，且该厚度受到牙位、距离窦底高度、有无牙颌等因素影响。研究发现距离窦底高度越高，骨壁厚度越大；完全无牙颌组的骨壁厚度小于部分无牙组，该差异具有统计学意义；第一磨牙骨壁厚度最大，第二前磨牙和第二磨牙厚度最小[43]。Danesh-Sani 等对 860 侧上颌窦 CBCT 影像进行观测，结果显示无牙组的骨壁厚度小于有牙组，该结果支持上述研究的结论，但该结果无显著性统计学差异；第一前磨牙、第二前磨牙、第一磨牙骨壁厚度相近，第二磨牙骨壁厚度最小[44]。LIM 等以眶底为标志点，向下测量，发现骨壁厚度随高度增高而增厚，从尖牙区到第一磨牙区逐渐增厚，第二磨牙区厚度最小，该结果也进一步印证了之前的研究[45]。综上所述，上颌窦侧壁厚度随距离窦底高度升高而增厚，在第一磨牙处厚度最厚，第二磨牙厚度最薄，同时，有无牙颌也会对侧壁厚度造成一定影响[46]。

对于需要行上颌窦外提升术的患者，术前测量上颌窦侧壁厚度，有利于更精准地评估手术难度，进一步辅助手术入路的选择，具有一定的临床现实意义。

7. 上颌窦侧壁血管

上颌窦侧壁血管是由上牙槽后动脉和眶下动脉在上颌窦侧壁吻合而形成[47]，其损伤是引起上颌窦外提升术围术期出血的主要原因[48]。为减少出血并发症，术前通过 CBCT 对上颌窦侧壁动脉的位置、直径进行观测显得尤为重要。然而，并不是所有上颌窦动脉在 CBCT 图像上都能够有所体现。研究发现，在尸解中可以 100%发现上颌窦侧壁血管的存在[49]，而 CBCT 图像上的检出率仅为 61.25%~94.98% [50]。其原因可能是有些侧壁血管直径较小，或位于窦内及骨壁浅表，与软组织无明显分界，从而致其在 CBCT 图像上无法完全显现[50]。

上颌窦侧壁血管的直径是影响术中出血的重要因素之一，一般认为血管直径小于 1 mm，损伤血管对手术影响较小，血管直径越大，出血的风险也随之越高，大于 2 mm 的血管损伤则被认为会引起较严重的出血。Fayek 等对 600 例上颌窦 CBCT 图像测量得到，血管平均直径在 1.0 ± 0.5 mm，管径小于 1 mm 的占 55.8%，大于 2 mm 的占 4.0% [51]。Karslioglu 等学者得出的结果，管径小于 1 mm 占 44%，大于等于 1 mm 占 56% [47]。Danesh-Sani 等对 860 例上颌窦 CBCT 图像测量得到，血管直径小于 1 mm 的占 37.8%，1~2 mm 的占 55.8%，大于 2 mm 的占 6.4% [44]。可见侧壁血管直径小于 2 mm 占多数。

根据上颌窦侧壁血管与骨壁的关系，可将其分为骨内型(69.6%)、浅表型(24.3%)、窦内型(6.1%) [44]，其中以骨内型占大多数[47] [51]；根据血管的垂直高度，研究中分别采用了血管下缘距离牙槽嵴顶和上颌窦底的高度，临床中也需要对这两者进行测量，利于进一步辅助上颌窦外提升术的开窗设计。

8. 小结

上颌窦各个局部解剖形态较为复杂，且易出现变异，对上颌窦提升的术中、术后都可能产生一定影响，如黏膜穿孔、出血、上颌窦炎等。CBCT 能够对上颌窦各个解剖结构达到较为清楚的显像，比如在上颌窦侧壁血管的显影上明显优于传统 CT [50]，能够为医生提供很好的参考价值。因此，在上颌窦提升术前临床医生借助 CBCT 对上颌窦解剖进行观测非常具有临床意义。

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