

· 影像医学 ·

牙源性上颌窦炎的锥形束CT影像学特征研究

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[摘要] 目的: 分析牙源性上颌窦炎(odontogenic maxillary sinusitis, OMS)锥形束CT(cone-beam computed tomography, CBCT)图像的影像学特征。方法: 收集196例OMS患者的CBCT数据, 利用专用软件NNT重建和观察, 对导致OMS的病因进行分析, 包括病原牙/牙根的根尖周病或牙周病与上颌窦底(maxillary sinus floor, MSF)的关系、根管治疗质量、MSF的完整性、窦内黏膜增厚等, 测量最大黏膜厚度和最小MSF厚度。结果: 根尖周病是窦内黏膜增厚最重要的危险因素。上颌磨牙导致的OMS是前磨牙的5.21倍, 且上颌第一磨牙(maxillary first molar, MFM)明显高于第二磨牙。MFM的近颊根(23.37%)和腭根(20.31%)与OMS关系最密切; MSF破坏后黏膜增厚更明显($P < 0.05$)。根管治疗不完善与OMS最相关, 尤其是根管清理不到位(35.25%)和根管遗漏(31.15%)。在遗漏根管中, 44.74%为MFM的近颊根第二根管。结论: 完善的根管治疗并有效控制根尖感染、保护MSF的完整性是减少OMS发生的重要因素。

[关键词] CBCT; 上颌后牙; 上颌窦; 牙源性上颌窦炎

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The radiographic features of odontogenic maxillary sinusitis on cone-beam computed tomography images

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[Abstract] **Objective:** To analyze the radiographic characteristics of odontogenic maxillary sinusitis (OMS) using cone-beam computed tomography (CBCT) images. **Methods:** CBCT data of 196 patients with OMS was collected, and was analyzed using NNT software. The etiologies of OMS and the situations of the etiologic teeth/roots were assessed, including the relationship between the radiographic periapical lesion or periodontal disease and the maxillary sinus floor (MSF), the previous endodontic therapy quality of the etiologic tooth/root, the integrity of the MSF and mucosal thickening. The maximum mucosal thickness and the minimum MSF thickness were measured. **Results:** Periapical lesion was the most important risk factor related to sinus mucosal thickening. Molars were 5.21 times more likely to be involved than premolars, whereas maxillary first molars (MFMs) were significantly higher than second molars (MSMs) to be involved ($P < 0.05$). Mesio buccal (23.37%) and palatal roots (20.31%) of MFM were the common etiologic roots associated with OMS. The mean maximum mucosal thickness showed significant differences between destroyed and not destroyed MSF ($P < 0.05$). The correlation between inadequate endodontic treatment and OMS was closest, especially poor clean and obturation (35.25%) and missed canals (31.15%). Of the missed root canals, 44.74% were the second mesio buccal root canals of MFM. **Conclusion:** Adequate root canal treatment for effective control of apical infection and the protection of the MSF integrity are important factors for reducing the occurrence of OMS.

[Key words] cone-beam computed tomography; maxillary posterior teeth; maxillary sinus; odontogenic maxillary sinusitis

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上颌后牙根尖与上颌窦底(maxillary sinus floor, MSF)关系密切,超过20%的上颌第二磨牙(maxillary second molar, MSM)的近颊根和上颌第一磨牙(maxillary first molar, MFM)的腭根延伸到MSF的上方或内部^[1]。上颌后牙根尖周的感染或炎症可直接或通过骨髓、血管和淋巴管扩散到上颌窦^[2],导致牙源性上颌窦炎(odontogenic maxillary sinusitis, OMS)。此外,拔牙或根尖周手术时上颌窦穿孔,根管冲洗液和充填物、牙胶尖或其他异物在治疗过程中进入上颌窦也可能引起OMS^[3-4]。OMS占上颌窦炎病例的10%~24%^[5-6],常引起口腔颌面部的持续胀痛,甚至头痛和喉咙痛^[7]。

OMS缺乏特异性的症状和体征,临床诊断困难。X线检查是诊断OMS的重要手段。正常上颌窦的X线影像特征是窦壁光整,窦腔清晰,内衬1层紧贴骨膜的呼吸黏膜,即Schneiderian膜,厚度为0.8~1.0 mm^[8]。当病原牙导致窦内黏膜厚度大于2 mm时即发生OMS^[9]。二维成像技术曲面体层片和根尖片很难准确显示上颌后牙与MSF之间的解剖关系^[10-11],也不能准确观察Schneiderian膜的变化。口腔锥形束CT(cone-beam computed tomography, CBCT)可以提供细节丰富的高分辨率图像,实现目标区域的三维可视化,因此广泛应用于复杂口腔临床问题的诊疗中^[12-14]。

许多学者利用CBCT图像研究了上颌后牙根尖与MSF之间的关系,通常上颌后牙根尖与MSF的距离由前向后逐渐变小^[1,15-16],因此第二前磨牙的根尖与MSF的关系比第一前磨牙更密切^[17],磨牙与MSF的关系比前磨牙更密切^[1]。有研究证实,MSM的近颊根与MSF最接近^[1,13,18-19],其次是MFM的腭根^[17];也有研究认为MSM的远颊根最接近MSF^[15,20]。然而关于上颌后牙根尖与OMS的关系,尤其是根管治疗(root canal treatment, RCT)后的牙根与OMS的关系研究较少。因此,本回顾性研究的目的是利用CBCT图像分析OMS的影像学特征,为临床OMS的诊疗提供参考。

1 对象和方法

1.1 对象

收集南京医科大学附属口腔医院颌面医学影像科2018年1月—2020年6月的196例(男97例,女99例)CBCT影像数据,包括187例单侧OMS和9例双侧OMS,共211颗病原牙,患者年龄(46.24±15.99)岁(15~87岁)。所有患者均采用CBCT机(NewTom 5G

或VGi;QR srl, Verona, 意大利)扫描,参数:110 kV, 3~9 mA,扫描视野(field of view, FOV)8 cm×12 cm~16 cm×18 cm,体素0.30 mm。纳入标准:影像学报告诊断为上颌窦炎。排除标准:①非牙源性或不明原因的上颌窦炎^[21];②有限FOV不能完全显示增厚的黏膜;③无牙颌;④上颌后牙根尖区存在伪影影响观察。本研究经南京医科大学附属口腔医院伦理委员会批准(PJ2017-080-001)。

1.2 方法

所有CBCT数据均由1名牙髓病医师与1名放射科医师同时重建与分析,两者经研究前的CBCT图像进行校准,Cohen's kappa统计分析显示两者之间高度一致性。所有CBCT数据均采用NNT 10.0软件(QR srl, Verona, 意大利)进行分析,采用矢状位、冠状位和轴位图放大4倍,设置层间隔为0.3 mm。如果两者的诊断出现分歧,再与1位高年资口腔放射学专家讨论后达成共识。

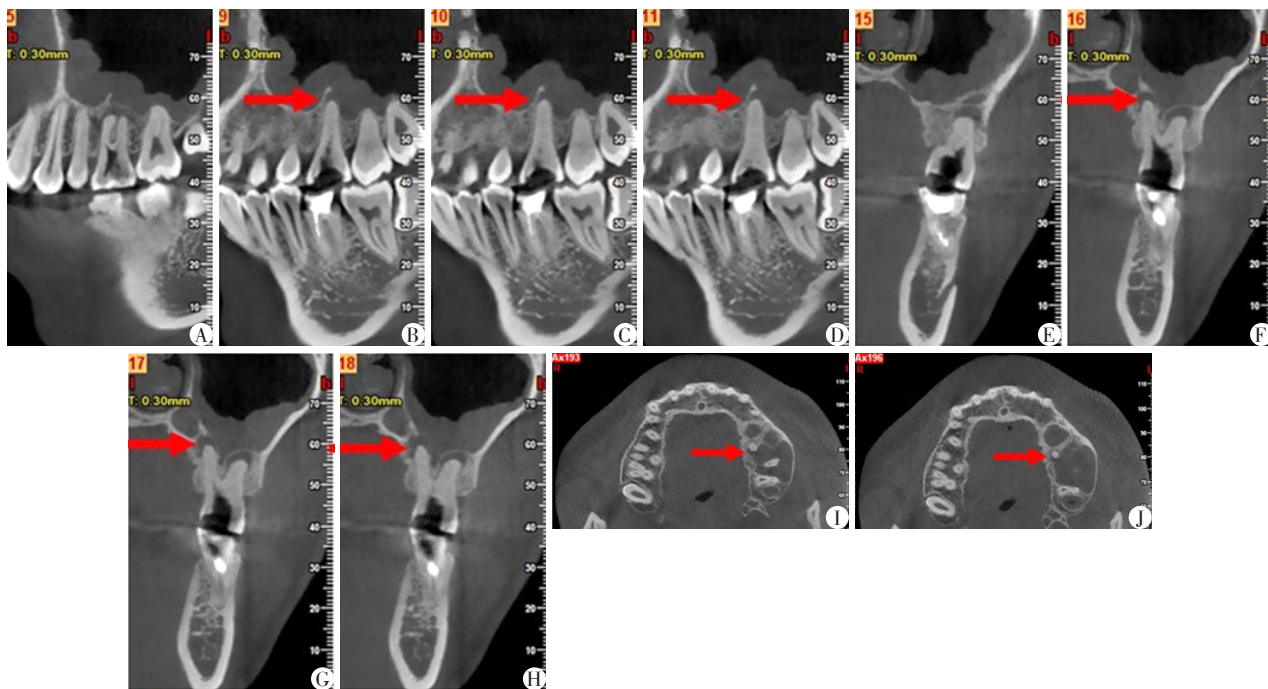
记录OMS的病因及病原牙或牙根的情况,包括根尖周病或牙周病与MSF的关系、病原牙或牙根的RCT质量、MSF完整性、黏膜增厚等。融合根记为单根。黏膜增厚的测量参照Maillet等的方法^[21],使用NNT 10.0软件在CBCT矢状位和冠状位图像上,测量OMS黏膜增厚区域的窦底黏膜厚度并记录最大值。如MSF未破坏,测量其最小厚度。所有测量均进行3次,记录平均值。

1.3 统计学方法

采用SPSS 22.0进行统计分析。以均数±标准差($\bar{x} \pm s$)计算最大黏膜厚度和最小MSF厚度。用Wilcoxon和Kruskal-Wallis检验评估MSF破坏与否的窦内黏膜厚度的差异。 $P < 0.05$ 为差异有统计学意义。

2 结果

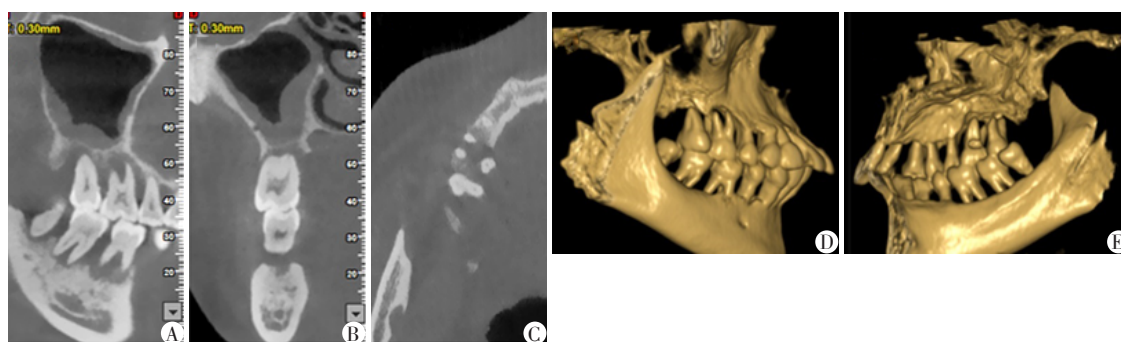
与OMS相关的211颗病原牙中,MFM 109颗占51.66%,其次分别是MSM 65颗(30.81%)、上颌第二前磨牙(maxillary second premolar, MSP) 29颗(13.74%)、上颌第一前磨牙(maxillary first premolar, MFP) 5颗(2.37%)和上颌第三磨牙(maxillary third molar, MTM) 3颗(1.42%)。导致OMS的病原牙中,磨牙177颗,前磨牙34颗,磨牙是前磨牙的5.21倍,且MFM数量明显高于MSM。164颗(77.73%)病原牙有根尖周病(图1),28颗(13.27%)有重度牙周病(图2),19颗(9.00%)有根尖周病和重度牙周病。上颌后牙导致的OMS中,发生根尖周病的病原牙数量



A:近颊根和远颊根(矢状位);B-D:腭根(矢状位);E:近颊根(冠状位);F-H:远颊根和腭根(冠状位);I、J:腭根(轴位)(箭头所示)。

图1 左上颌第一磨牙根尖周病及左牙源性上颌窦炎CBCT图

Figure 1 CBCT images of a left maxillary first molar with periapical lesion associated with OMS



A:矢状位;B:冠状位;C:轴位;D:3D图(颊侧);E:3D图(腭侧)。

图2 右上颌第二磨牙伴重度牙周病及右牙源性上颌窦炎CBCT图

Figure 2 CBCT images of a right maxillary second molar with severe periodontitis associated with OMS

是发生牙周病的5.86(164/28)倍。116颗(54.98%)病原牙接受了RCT(表1)。

与OMS相关的牙根261个,最常见的是MFM的近颊根和腭根,其次是MSM的近颊根、MSP的牙根

表1 OMS相关病原牙的根尖或牙周病损情况

Table 1 The periapical lesion or periodontal disease of the etiologic teeth associated with OMS (n)

类别	根尖 周病	牙周 病	根尖周病+ 牙周病	总计
经过牙髓治疗	104	4	8	116
未行牙髓治疗	60	24	11	95
总计	164	28	19	211

和MFM的远颊根,所占比例分别为23.37%、20.31%、15.71%、11.49%和9.58%(表2)。141例被破坏的MSF平均最大黏膜厚度为(10.78±7.63)mm,64个未破坏MSF的平均最大黏膜厚度为(6.62±4.47)mm,差异有统计学意义(P<0.05)。如MSF未破坏,其平均厚度为(0.86±0.33)mm。

RCT不完善(包括根管清理和密闭性差、根管遗漏和根管超充)是导致OMS发生的最相关因素(图3),尤其是根管清理不到位(35.25%)和根管遗漏(31.15%)。遗漏根管中,44.74%为MFM的近颊第二根管(表3、图4)。此外,有14.75%的RCT牙存在病因不明的根尖周炎症。

表2 OMS相关病原牙的牙根

Table 2 The roots of the etiologic teeth associated with OMS

类别	MFP	MSP	MFM			MSM				MTM		
			MBR	DBR	PR	MBR	DBR	PR	FR	MBR	DBR	PR
根尖周病	5	25	53	20	36	34	10	12	6	2	0	0
牙周病	0	4	4	2	11	3	2	2	4	0	0	1
根尖周病+牙周病	0	1	4	3	6	4	4	2	1	0	0	0
合计	5	30	61	25	53	41	16	16	11	2	0	1

MBR:近颊根;DBR:远颊根;PR:腭根;FR:融合根。

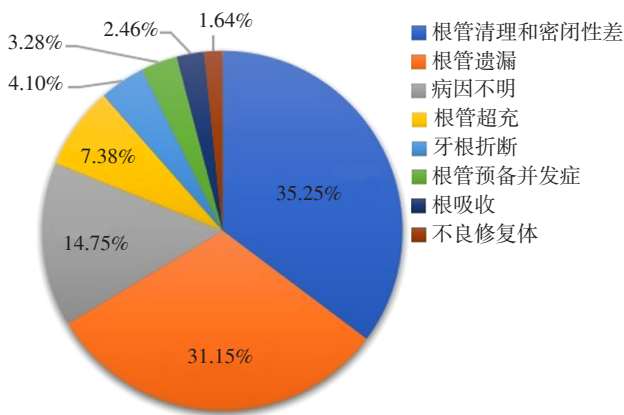


图3 与牙源性上颌窦炎相关的根管治疗失败牙的比例

Figure 3 The proportion of the failed endodontically treated teeth associated with OMS

表3 OMS相关病原牙的遗漏根管情况

Table 3 The omitted root canals of the etiologic teeth associated with OMS

根管位置	遗漏根管数目(n)	百分比(%)
MFP		
腭根管	1	2.63
MFM		
近颊第一根管	3	7.89
近颊第二根管	17	44.74
远颊根管	3	7.89
MSM		
近颊第一根管	5	13.16
近颊第二根管	5	13.16
远颊根管	4	10.53

3 讨论

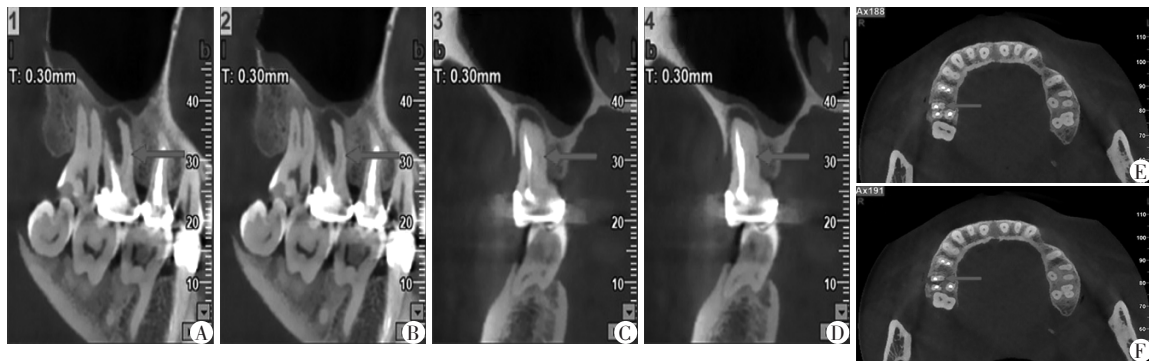
OMS是病原牙导致MSF变薄或破坏、上颌窦内黏膜局部增厚的疾病^[21]。MFM导致的OMS占比最高,其次分别是MSM和第二前磨牙。磨牙导致的OMS病例是前磨牙的5.21倍,而MFM导致的OMS病例数明显高于MSM。这可能是由于MFM的萌出早于MSM和MSP,使得它们发生根尖周炎和牙周病

的可能性更高,接受RCT的频率也更高^[22]。此外,MSP根尖与MSF之间的距离大于MSM和MFM,因此由MSP引起OMS的概率小于MSM和MFM。这与Maillet等^[21]的研究结果一致,即MSM和MFM导致OMS发生的可能性高于前磨牙。该研究还认为MSM和MFM导致OMS的可能性是相同的^[20],这与本研究的结果不同,可能是因为病例选择的人群不同。

根尖周病是窦黏膜增厚的重要危险因素^[23]。根尖周病的存在将窦内黏膜增厚和OMS发生的可能性提高了2.4倍和1.7倍^[24]。牙周炎被认为是OMS和Schneiderian膜增厚的另一个危险因素^[9,25]。在本研究中,77.73%的病原牙有根尖周病,13.27%的病原牙有重度牙周病,上颌后牙根尖周病导致的OMS是牙周病的5.86倍,提示控制根尖感染或促进根尖感染的愈合对预防OMS的重要性。此外,牙周感染与牙髓感染同时存在是有症状OMS黏膜增厚的主要原因。因此,口腔医生不仅要控制根尖感染,也要预防牙周疾病。

本研究中,MFM的近颊根与OMS的发生最密切,其次是MSM的近颊根、上颌第二前磨牙牙根和MFM的远颊根。可能是由于这些牙根靠近上颌窦底,根尖周的感染或炎症以及牙周病更有可能引起OMS。此外,尽管MFM近颊根尖距离上颌窦底并非最近,但高频率的RCT和高的治疗失败率也可能导致了这种现象。这与Maillet等^[21]的发现并不完全一致,该研究认为与OMS最相关是MFM的腭根,其次是MSM的近颊根,这也可能是所选标本的差异导致的。

充分的牙髓治疗和冠修复对初次RCT结果有显著影响^[26],根尖不完全封闭导致RCT失败率高达58%。在本研究中,116颗RCT牙齿与OMS相关,其中104颗牙齿存在根尖周病。RCT不完善与OMS的发生最相关,尤其是根管清理和封闭不良以及遗漏根管。这些因素也是RCT失败的常见原因,说明上颌后牙充分的RCT可有效控制根尖感染,并显著减



A,B:矢状位;C,D:冠状位;E,F:轴位(箭头所示)。

图4 右上颌第一磨牙近颊第二根管遗漏及右牙源性上颌窦炎CBCT图

Figure 4 CBCT images of the inadequate endodontic treatment of a right maxillary first molar with missed second mesio-buccal root canal associated with OMS

少OMS的发生。在本研究中,当MSF被破坏时,平均最大黏膜厚度显著大于MSF未被破坏的OMS ($P < 0.05$)。此外,当发生OMS且MSF未被破坏时,MSF的平均厚度不超过1 mm。这表明上颌后牙根尖与MSF的平均距离、MSF的完整性与OMS的发生有重要关系。根尖离MSF越近,窦底越薄,根尖炎症越容易进入上颌窦导致OMS^[27]。另外,即使仅有较薄的窦底也能阻止或延缓炎症向上颌窦的扩散,这提示在临床治疗中应重点保护MSF的完整性。

本研究发现14.75%的RCT牙得到了充分的根管充填,但仍存在不明原因的根尖周病并导致OMS。这可能是因为:①术前存在的根尖周病已导致OMS,患牙接受RCT后仍未能治愈根尖周病;②存在与OMS相关但影像学检查无法发现的错误操作,如挤出根尖孔的坏死牙髓、感染的牙本质碎片或冲洗剂。此外,随着年龄的增长上颌窦底黏膜增厚的发生呈增加趋势^[28],可能因为年龄增长与根尖周病和牙周病的发病率呈正相关^[29],然而不同年龄组根尖周病或牙周病与上颌窦底黏膜增厚的相关性需进一步研究。

根尖周病是导致OMS的主要原因,MFM及其近颊根与OMS的发生最密切。完善的根管治疗并有效地控制根尖感染、保护MSF的完整性是减少OMS发生的重要因素。

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