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· 临床研究 ·

# 前牙开殆患者颞下颌关节间隙及髁突形态的锥形束CT评价

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**【摘要】** 目的 应用锥形束CT(cone-beam CT, CBCT)对前牙开殆患者的颞下颌关节间隙及髁突形态进行测量分析,探讨前牙开殆患者与正常覆殆患者的颞下颌关节的差异。**方法** 选取2014年6月至2020年8月于南京大学医学院附属口腔医院正畸科就诊的前牙开殆患者54例(前牙开殆组)和正常覆殆患者54例(正常覆殆组),对其拍摄的颌面部CBCT图像使用多平面重建技术重建颞下颌关节矢状位及冠状位图像。使用Kamelchuk法测量颞下颌关节上、后、前间隙,根据髁突骨质情况将髁突形态分为正常型与异常型2类,对前牙开殆组和正常覆殆组进行关节间隙及髁突形态的统计学分析。将前牙开殆组根据开殆的程度分为3个亚组:① I°开殆组(开殆距离 < 3 mm);② II°开殆组(3 mm ≤ 开殆距离 ≤ 5 mm);③ III°开殆组(开殆距离 > 5 mm),比较3个亚组间关节间隙的差异。**结果** 前牙开殆组与正常覆殆组相比,颞下颌关节前、上间隙差异无统计学意义( $P > 0.05$ ),颞下颌关节后间隙显著增宽( $P < 0.01$ );前牙开殆组髁突骨质异常占52.8%,正常覆殆组骨质异常占21.3%,两组间具有显著性差异( $P < 0.01$ )。与I°和II°前牙开殆患者相比,III°前牙开殆患者髁突在关节窝内更靠前( $P < 0.05$ )。**结论** 前牙开殆患者的髁突在关节窝内位置更加靠前、髁突骨质异常比例较高。

**【关键词】** 锥形束CT; 颞下颌关节; 前间隙; 后间隙; 上间隙; 髁突形态; 前牙开殆; 正常覆殆; 正畸治疗

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**Evaluation of temporomandibular joint space and condylar morphology in patients with anterior open-bite based on cone-beam CT** LAI Zhanwen<sup>1</sup>, HU Ziyang<sup>2</sup>, PAN Xiao<sup>2</sup>, HAO Yanqing<sup>2</sup>, LIN Zitong<sup>2</sup>. 1. Guangxi Institute of Occupational Disease Prevention and Control & Guangxi Workers' Hospital, Nanning 530000, China; 2. Nanjing Stomatological Hospital, Medical School of Nanjing University, Department of Dentomaxillofacial Radiology Imaging, Nanjing 210008, China

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**【Abstract】 Objective** To investigate the difference of the temporomandibular joint between patients with anterior open-bite and normal overbite with cone beam CT (CBCT). **Methods** Fifty-four patients with anterior open bites and 54 patients with normal overbites were selected from the Department of Orthodontics, Nanjing Stomatological Hospital, Medical School of Nanjing University from June 2014 to August 2020. Sagittal and coronal images of the temporomandibular joint were reconstructed with multiplanar reconstruction technique. The Kamelchuk method was used to measure the superior, posterior and anterior space of the temporomandibular joint, and the condylar morphology was divided into two types: normal and abnormal. The joint space and condylar morphology of the anterior open-bite group and the nor-

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mal overbite group were statistically analyzed. The anterior open-bite group was divided into 3 subgroups: ① I° open-bite (open bite distance < 3 mm), ② II° open-bite (open bite distance  $\geq$  3 mm and  $\leq$  5 mm) and ③ III° open-bite (open bite distance > 5 mm). The difference of overbite spaces of the temporomandibular joint was compared among these three subgroups. **Results** Compared to the normal group, no significant differences were found for the anterior and superior space of the temporomandibular joint in the anterior open-bite group ( $P > 0.05$ ), but the posterior space increased significantly ( $P < 0.01$ ). A total of 52.8% of patients in the anterior open-bite group had abnormal condyles, whereas 21.3% of patients in the normal group, overbite significant differences was found between the two groups ( $P < 0.01$ ). Compared with patients with I° and II° openbite, the condyle of patients with III° open bites was more forward in the fossa ( $P < 0.05$ ). **Conclusion** The position of the condyle in the fossa of patients with anterior open bites is more forward, and abnormal condylar bone is more common found.

**【Key words】** cone-beam CT; temporomandibular joint; anterior space; superior space; posterior space; condylar morphology; anterior open-bite; normal overbite; orthodontic treatment

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颞下颌关节在维持良好的咬合功能和口颌系统平衡方面起着重要作用<sup>[1]</sup>。前牙开殆是正畸临床治疗中常见的错殆畸形,因其所产生的殆干扰及下颌运动障碍而影响颞下颌关节功能,已被确定为颞下颌关节紊乱病的重要诱发因素之一<sup>[2-4]</sup>。本研究应用锥形束CT(cone-beam CT, CBCT)对前牙开殆患者的颞下颌关节间隙及髁突形态进行测量分析,评价这类患者与正常覆殆患者的颞下颌关节是否存在明显差异,为开殆患者正畸正颌治疗提供参考依据。

## 1 材料与方法

### 1.1 研究对象

选取2014年6月至2020年8月在南京大学医学院附属口腔医院正畸科就诊的前牙开殆患者54例及正常覆殆患者54例。纳入标准:年龄18~36岁,无正畸治疗史;上下颌牙列式:7-7(不考虑上下颌8情况);安氏I类错殆;无关节区外伤史;无磨牙症;无全身风湿类风湿及其它系统疾病史。此外,前牙开殆组纳入标准:上下颌3-3开殆,上下颌4-5开殆或正常覆殆,上下颌6、7正常咬合;正常覆殆组纳入患者:上下颌3-3正常覆殆,4-7正常咬合。

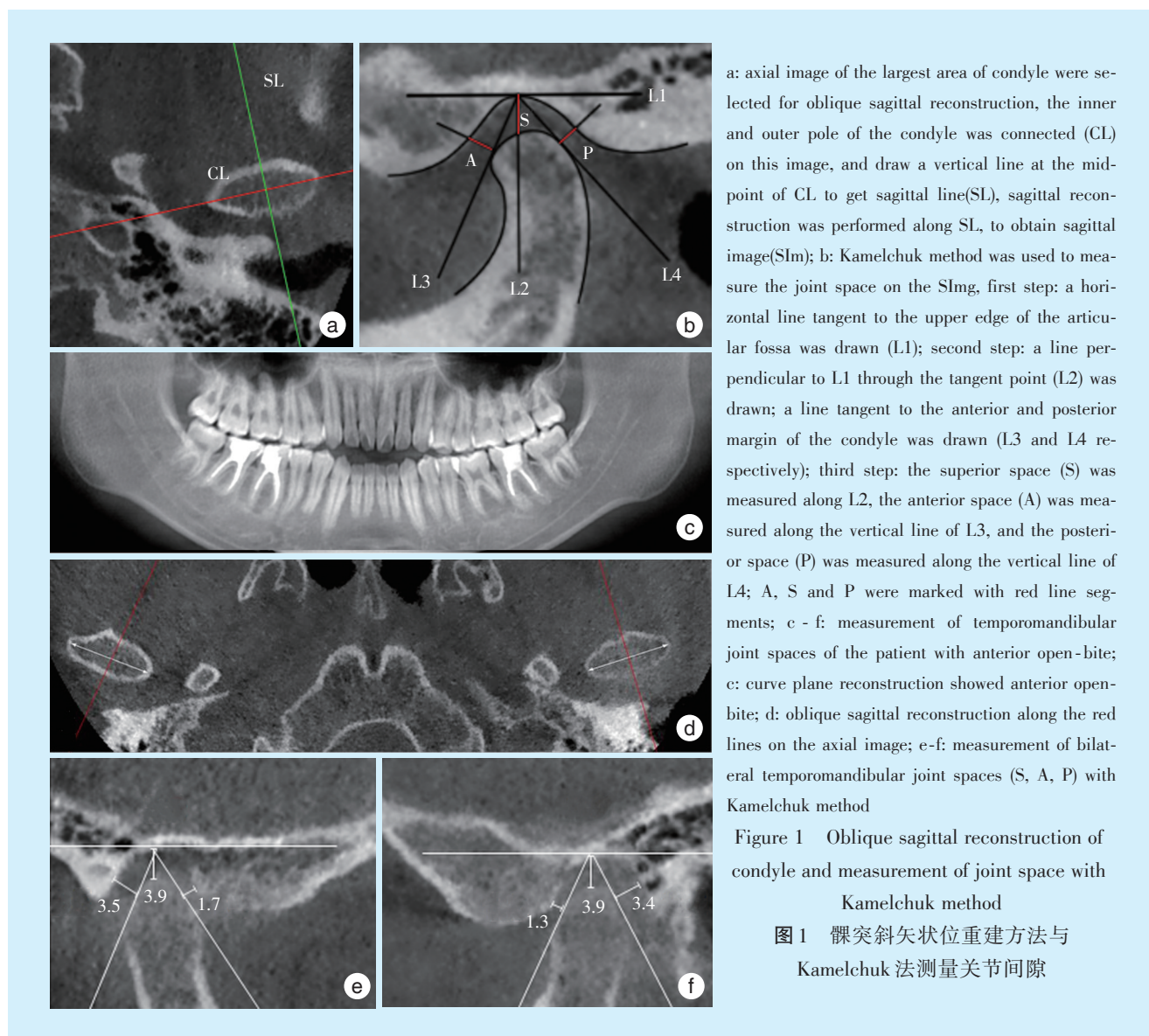
### 1.2 研究方法

**1.2.1 CBCT扫描** 所有患者颌面部CBCT扫描使用NewTom VG(QR srl, Verona, 意大利),体素分辨率均为0.25 mm。患者呈坐位,咬合平面与地面平行。扫描参数:管电压110 kV,重建层厚0.25 mm,

扫描视野15 cm × 15 cm。

**1.2.2 颞下颌关节间隙测量** 使用CBCT内置NNT9.0软件(QR srl, Verona, 意大利)进行三维重建及图像测量分析。首先选取髁突最大面积轴位图像(axial image, AIm),连接髁突内极及外极得到髁突最大近远中径连线(cortical line, CL),并在其中点作其垂线(sagittal line, SL)(图1a),沿着该垂线进行斜矢状面重建,得到髁突斜矢状位重建图(sagittal image, SIm)。在该重建图像上使用Kamelchuk法测量关节间隙<sup>[5]</sup>:先作1条水平线L1,使L1线与关节窝上缘相切;过切点作L1的垂线(标记为L2),作髁突前缘、后缘的切线(分别标记L3和L4);通过L2测量关节上间隙(S),作L3的垂线测量关节前间隙(A),作L4的垂线测量关节后间隙(P)(图1b)。前牙开殆组典型病例颞下颌关节间隙测量见图1c-1f。测量由一名影像科医师盲法进行,所有的测量值取3次测量的均值,精确到0.1 mm。1个月后,对前牙开殆组及正常覆殆组关节间隙进行第二次测量。

**1.2.3 髁突形态评价** 在上述轴位图像上分别顺着CL和SL的方向进行连续多层面重建(重建层厚和层距均为0.25 mm),随后对髁突形态进行评价<sup>[6]</sup>,将单侧髁突形态分为2类,分别为正常型与异常型。正常型:髁突呈圆柱形、椭圆形或双斜形且可见连续不断的、整齐致密而又较薄的密质骨边缘,其下方骨纹理结构均匀;异常型:髁突硬化,髁突前斜面模糊不清,髁突小凹陷缺损,髁突前斜面广泛破坏,髁突囊样变,髁突骨质增生,髁突磨



a: axial image of the largest area of condyle were selected for oblique sagittal reconstruction, the inner and outer pole of the condyle was connected (CL) on this image, and draw a vertical line at the midpoint of CL to get sagittal line(SL), sagittal reconstruction was performed along SL, to obtain sagittal image(SIm); b: Kamelchuk method was used to measure the joint space on the SIm, first step: a horizontal line tangent to the upper edge of the articular fossa was drawn (L1); second step: a line perpendicular to L1 through the tangent point (L2) was drawn; a line tangent to the anterior and posterior margin of the condyle was drawn (L3 and L4 respectively); third step: the superior space (S) was measured along L2, the anterior space (A) was measured along the vertical line of L3, and the posterior space (P) was measured along the vertical line of L4; A, S and P were marked with red line segments; c - f: measurement of temporomandibular joint spaces of the patient with anterior open-bite; c: curve plane reconstruction showed anterior open-bite; d: oblique sagittal reconstruction along the red lines on the axial image; e-f: measurement of bilateral temporomandibular joint spaces (S, A, P) with Kamelchuk method

Figure 1 Oblique sagittal reconstruction of condyle and measurement of joint space with Kamelchuk method

图1 髁突斜矢状位重建方法与Kamelchuk法测量关节间隙

平、变短小,关节结节、关节窝硬化<sup>[7]</sup>。评价髁突形态时,只要有一副图像上出现骨质异常则评价为异常型。由两名口腔颌面医学影像科医生分别评价髁突形态,当两者评价不一致时,由第三名高年资口腔颌面影像科医师评价得到最终的结果。一个月后,其中一名评价者对前牙开殆组54例及正常覆殆组54例进行第二次髁突骨质形态评价。颞下颌关节上、后、前间隙的组内相关性系数为0.895,两名评价者之间Kappa值为0.796,其中一名评价者两次评价的Kappa值为0.883。

1.2.4 前牙开殆组的开殆程度 在曲面重建图像上测量上下颌3-3的开殆距离,取最大距离进行开殆程度的分级,分为Ⅰ°开殆(开殆距离 < 3 mm),Ⅱ°开殆(3 mm ≤ 开殆距离 ≤ 5 mm)和Ⅲ°开殆(开殆距离 > 5 mm)。

### 1.3 统计学分析

采用SPSS 23.0软件对数据进行分析,计量资料以均数±标准差表示,采用独立样本t检验;计数资料以频数表示,采用卡方检验。使用组内相关系数评价前后两次颞下颌关节间隙测量的相关性。 $P < 0.05$ 为差异有统计学意义。

## 2 结果

### 2.1 患者基本资料

前牙开殆组:54例,年龄18~35岁,平均年龄(22.9 ± 5.0)岁,其中男性19例,女性35例。正常覆殆组:54例,年龄18~36岁,平均年龄(22.8 ± 6.0)岁,其中男性13例,女性41例。

### 2.2 髁突在关节窝内的位置

正常覆殆组与前牙开殆组髁突在关节窝内的



位置见表1。关节上及关节前间隙无显著性差异;两组间关节后间隙具有显著性差异( $P < 0.01$ );前牙开殆组关节后间隙明显增宽,与正常覆殆组相比,前牙开殆组患者髁突在关节窝内更靠前。

表1 正常覆殆组与前牙开殆组髁突在关节窝内的位置

Table 1 Comparison of position of condyles in normal overbite group and anterior open-bite group mm,  $\bar{x} \pm s$

Group		Anterior space	Superior space	Posterior space
Normal overbite	Left	2.00 ± 0.75	2.75 ± 0.97	2.01 ± 0.58
	Right	1.95 ± 0.60	2.68 ± 0.78	2.02 ± 0.56
	Bilateral	1.98 ± 0.68	2.72 ± 0.88	2.02 ± 0.57
Anterior open-bite	Left	1.98 ± 0.78	2.72 ± 0.79	2.49 ± 1.00
	Right	2.07 ± 0.85	2.59 ± 0.90	2.20 ± 0.94
	Bilateral	2.02 ± 0.82	2.66 ± 0.85	2.35 ± 0.98
<i>t</i>		-0.45	0.53	-3.02
<i>P</i>		0.66	0.60	< 0.01

### 2.3 髁突形态

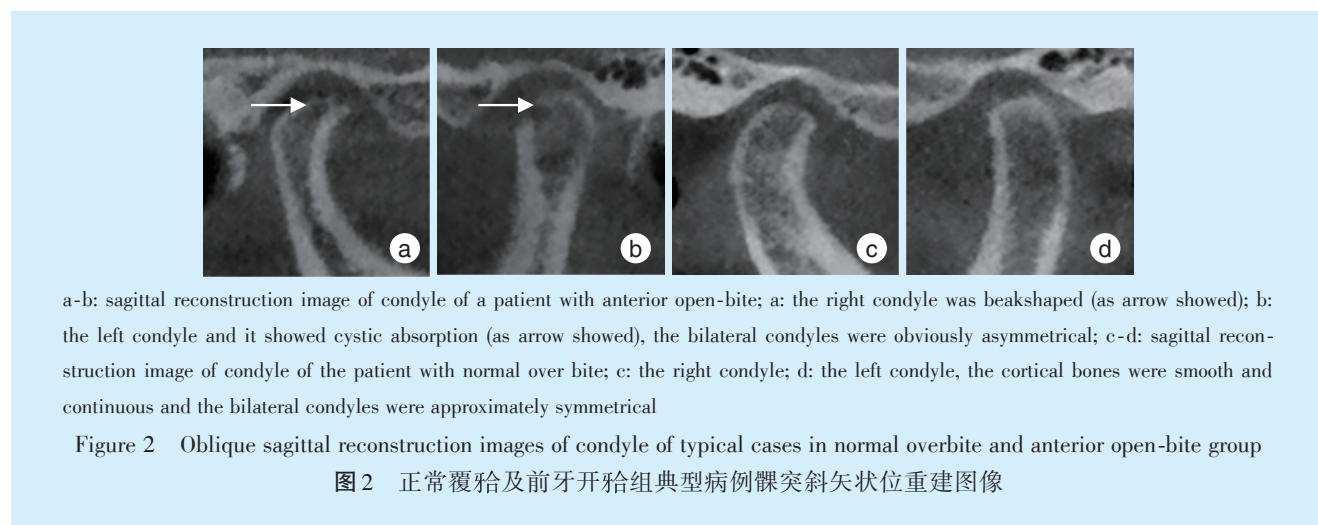
正常覆殆组髁突形态以正常型居多,异常型

较少;前牙开殆组异常型髁突所占比例较高(52.8%),明显高于正常覆殆组(21.3%);前牙开殆组与正常覆殆组髁突形态对比有统计学差异( $P < 0.01$ ),见表2。两组典型病例髁突斜矢状位重建图像见图2,前牙开殆患者右侧髁突矢状位图可见髁突前斜面骨质增生,左侧髁突前斜面可见小囊腔样吸收,且该患者两侧髁突形态明显不对称;正常覆殆患者右侧及左侧髁突骨皮质连续光整,双侧髁突大致对称。

表2 正常覆殆组和前牙开殆组髁突形态

Table 2 Comparison of morphology of condyles in normal overbite group and anterior open-bite group n(%)

Group	Normal	Abnormal
Normal overbite	85(78.7%)	23(21.3%)
Anterior open-bite	51(47.2%)	57(52.8%)
$\chi^2$		22.95
<i>P</i>		< 0.01



### 2.4 关节位于关节窝内的位置

不同前牙开殆程度患者关节位于关节窝内的位置见表3。Ⅲ°开殆患者对比Ⅰ°及Ⅱ°开殆患者关节前间隙减小并有统计学差异(Ⅲ° vs. Ⅰ°:  $P < 0.001$ ; Ⅲ° vs. Ⅱ°:  $P = 0.049$ ), Ⅲ°开殆患者髁突在关节窝内更靠前。

### 3 讨论

颞下颌关节具有复杂的结构和功能,负重是其重要功能之一。髁突前斜面、关节盘中带及关节节后斜面区域是颞下颌关节的最大受力部

位<sup>[7]</sup>。髁突作为下颌骨中最重要且最活跃的生长发育中心,可在不同的咬合力作用下发生改建<sup>[8-10]</sup>。研究表明咬合类型与颞下颌关节形态密切相关,特别是前牙的覆殆覆盖关系<sup>[7]</sup>。姚霜等<sup>[11]</sup>对不同垂直骨面型的成人骨性Ⅱ类错殆患者的髁突形态研究表明,高角组患者具有细而长的髁突头,而低角组患者则具有短而粗的髁突头。

对颞下颌关节间隙及形态评价以往常采用颞下颌关节薛氏位片,但其拍摄对操作技师要求较高,部分患者髁突及关节窝由于颞骨的重叠显示清晰度不足,且拍摄过程中存在一定的不稳定

表3 不同程度前牙开殆患者关节位于关节窝内的位置  
Table 3 Comparison of position of condyles among different anterior open-bite level patients mm,  $\bar{x} \pm s$

Degree of anterior open-bite	Anterior joint space	Superior joint space	Posterior joint space
I° open-bite	2.16 ± 0.94	2.70 ± 0.89	2.27 ± 1.11
II° open-bite	1.97 ± 0.56	2.69 ± 0.66	2.35 ± 0.59
III° open-bite	1.65 ± 0.47	2.50 ± 0.87	2.58 ± 0.89
II° vs. I°	<i>t</i> 0.924 <i>P</i> 0.390	0.046 0.960	0.046 0.960
III° vs. I°	<i>t</i> 3.198 <i>P</i> < 0.001	0.846 0.400	-1.116 0.270
III° vs. II°	<i>t</i> 2.010 <i>P</i> 0.049	0.784 0.440	-0.968 0.320

性<sup>[6]</sup>。CBCT近年来被广泛运用于口腔颌面部多种疾病的诊断<sup>[12-14]</sup>,对于颞下颌关节而言,CBCT亚毫米级的空间分辨率可清晰显示髁突骨质改变,并对颞下颌关节各间隙进行精确测量<sup>[15-16]</sup>。CBCT拍摄相对更加简单方便,可重复性高。但是也需要注意,对于CBCT拍摄图像需要建立标准化多平面重建方法,以保证不同患者间颞下颌关节间隙测量及髁突形态评价的一致性<sup>[1,17-18]</sup>。本研究中所有患者均先选取髁突最大面积轴位图像,在此基础上分别顺着CL和SL的方向进行连续多层面冠状位和矢状位重建,层厚和层距均为0.25 mm;颞下颌关节间隙测量的组内相关系数为0.895,而髁突形态评价的Kappa值则均在0.75以上,表明本研究所采用的方法具有良好的稳定性。

本研究对前牙开殆正畸患者及正常覆殆患者的颞下颌关节前、上、后间隙进行测量,结果显示,与正常覆殆组相比,前牙开殆组后间隙显著增宽,髁突在关节窝内较为靠前;且与I°和II°前牙开殆患者相比,III°前牙开殆患者关节前间隙显著减小。以上结果说明,前牙开殆组髁突在关节窝内的位置靠前,且开殆程度越严重髁突越靠前,证实了咬合关系对髁突在颞下颌关节窝中的位置存在影响,分析可能是由于前牙开殆患者的咬合关系不稳定,前牙失去切导斜度,导致髁突在关节窝中更靠前方。

本研究中将髁突形态分为正常型和异常型两类,结果显示,两组间髁突形态具有显著性差异,前牙开殆组骨质异常发生率明显增高。前牙开殆是少数几个被确定与关节病有关的殆因素之一,虽然不会导致明显的颞下颌关节紊乱病,但是会

导致髁突前移。前牙开殆前伸运动时失去切道斜度会导致关节运动时的组织生理异常,并可能因失去稳定的咬合运动导致的关节左右位置不对称<sup>[17]</sup>。这同时也提示,对于这类前牙开殆患者在正畸治疗中需要更多的关注颞下颌关节的情况,对于术前就存在明显的颞下颌关节间隙及形态改变的患者,在治疗前及治疗中一定要充分关注颞下颌关节的状态,避免正畸治疗诱发严重的颞下颌关节紊乱病。

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