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• 临床研究 •

青少年前牵引后颞下颌关节改变的相关性分析

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【摘要】目的 研究青少年骨性Ⅲ类错殆患者前牵引对颞下颌关节的影响。**方法** 选择恒牙早期骨性Ⅲ类错殆患者29例,于前牵引治疗前后进行头影测量及坐标系统测量,定量分析殆颌面及颞下颌关节位置和结构的改变,并进行相关性分析。**结果** 在前牵引矫治后,头影测量发现殆颌面发生明显改变,上齿槽座点-鼻根点-下齿槽座点角(subspinale-nasion-supramental angle, ANB)增加 $3.97^{\circ} \pm 2.32^{\circ}$ ($P < 0.001$),上中切牙长轴与前颅底平面相交的交角(upper incisor and sella-nasion line angle, U1-SN)增加 $4.97^{\circ} \pm 5.51^{\circ}$ ($P < 0.001$),下中切牙长轴与GoGn连线的交角(lower incisor and gonion-gnathion line angle, L1-MP)减小了 $1.26^{\circ} \pm 1.41^{\circ}$ ($P = 0.008$),GoGn连线与SN连线的交角(gonion-gnathion line and sella-nasion line angle, MP-SN)增加了 $1.02^{\circ} \pm 3.90^{\circ}$ ($P = 0.003$)。颞下颌关节坐标系统测量发现蝶鞍点到关节窝后缘点在X轴向上的距离(sella to FP = distance on the X-axis, S-Fpx)减少了 $(0.16 \pm 1.52)\text{mm}$ ($P = 0.041$),蝶鞍点到髁状突前缘点在Y轴向上的距离(sella to Ci distance on the Y-axis, S-Ciy)距离显著减小 $(0.09 \pm 2.03)\text{mm}$ ($P = 0.028$),但颞下颌关节间隙无显著改变。相关性分析发现,关节窝的后缘位置与U1-SN呈中等负相关关系($r = -0.427$, $P = 0.042$),髁状突的前缘位置与ANB有中等正相关关系($r = 0.425$, $P = 0.043$),关节间隙与殆颌面改变均无相关。**结论** 青少年骨性Ⅲ类错殆前牵引矫治对关节窝及髁状突改变有一定影响,但对关节间隙没有影响。

【关键词】 恒牙早期; 青少年; 骨性Ⅲ类错殆; 颞下颌关节; 殆颌面; 前牵引矫治; 相关性分析

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Correlation analysis of temporomandibular joint changes after maxillary protraction in adolescent patients

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【Abstract】Objective To study the effect of anterior traction on the temporomandibular joint in adolescent patients with skeletal Class Ⅲ malocclusion. **Methods** Twenty-nine patients with early permanent dentition with skeletal class Ⅲ malocclusions were measured by cephalometry and a coordinate system before and after maxillary protraction. The correlation between dentofacial structures and the temporomandibular joint was analyzed. **Results** After maxillary protraction, cephalometric measurements showed that the dentofacial structure changed significantly; ANB increased by

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$3.97^{\circ} \pm 2.32^{\circ}$ ($P < 0.001$); U1-SN increased by $4.97^{\circ} \pm 5.51^{\circ}$ ($P < 0.001$); L1-MP decreased by $1.26^{\circ} \pm 1.41^{\circ}$ ($P = 0.008$); and MP-SN increased by $1.02^{\circ} \pm 3.90^{\circ}$ ($P = 0.003$). The coordinate system measurement showed that the S-Fpx was decreased by 0.16 ± 1.52 mm ($P = 0.041$), the S-Ciy distance was significantly decreased by 0.09 ± 2.03 mm ($P = 0.028$), and there was no significant change in the temporomandibular joint spaces (A, P, and C) ($P > 0.05$). Correlation analysis showed a moderate negative correlation between the posterior margin of the temporomandibular joint fossa and U1-SN ($r = -0.427$, $P = 0.042$). There was a moderate positive correlation between the leading edge of the condyle and ANB ($r = 0.425$, $P = 0.043$); there was no correlation between the joint space and dentofacial changes. **Conclusion** After treatment with maxillary protraction for adolescent skeletal class III malocclusion, maxillary protraction had some effect on changes in the temporomandibular joint fossa and condyle and had no effect on the joint space.

【Key words】 early permanent dentition; adolescents; skeletal class III malocclusion; temporomandibular joint; dentofacial structure; maxillary protraction; correlation analysis

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前牵引是矫正青少年骨性Ⅲ类错殆的有效方法,其最佳治疗时间在混合牙列期^[1]。在临床上对错过最佳治疗时机的恒牙早期患者进行前牵引治疗,仍可得到上颌骨前移、面型改善的结果^[2]。近年来许多研究关注正畸治疗与颞下颌关节紊乱病的关系,通过有限元分析前牵引对颞下颌关节的压应力分布以及有限元分析评估恒牙早期患者对前牵引治疗产生的颌面效应^[3-4],但尚无对恒牙早期患者前牵引治疗后颌面部改变与颞下颌关节改建的相关性研究。本研究通过观察前牵引矫治前后恒牙早期患者的颌面部及颞下颌关节的改变,并对二者进行相关性分析,探讨前牵引矫治后颌面部改变对青少年颞下颌关节结构的影响。

1 资料和方法

1.1 研究对象

选取2010-2013年于河北医科大学第一医院口腔正畸科就诊的青少年骨性Ⅲ类错殆患者29例,本研究已获得河北医科大学第一医院伦理委员会批准,批号:20200513。纳入标准:①年龄12~14岁;②恒牙早期(上下颌第二恒磨牙未建殆);③上齿槽座点-鼻根点-下齿槽座点角(subspinale-nasion-supramental angle, ANB) $< 0^{\circ}$,前牙反覆殆反覆盖,下颌不可后退至前牙对刃关系;④面部基本对称,无偏斜。排除标准:有颞下颌关节疾患、面部手术外伤史及正畸治疗史者。

所有研究对象均采用固定式前牵引治疗,口

内部分为牙支持式前牵引装置(手工制作),口外部分为前牵引面罩(杭州西湖生物材料有限公司,中国)。前牵引力量为300~500 g/侧,方向为与殆平面呈 $20^{\circ} \sim 30^{\circ}$ 前下方牵引。所有研究对象在前牵引治疗前后拍摄X线头颅定位侧位片,由同一名专业医师在连续时间内按统一标准测量3次,并由2名高年资医师负责审核测量数据。

1.2 观察指标及测量方法

1.2.1 颌面部结构的定点及测量方法^[5] 首先确定颌颌面及关节窝、髁状突标志点(图1a),然后建立坐标系:前颅底平面(sella-nasion plane, SN)顺时针旋转 7° 为X轴,过S点垂直于水平轴的直线作为Y轴。将关节窝、髁状突各标志点分别向X轴、Y轴做投影,测量各标志点的投影到S点的距离代表颞下颌关节窝和髁状突位置矢状向线距和垂直向线距(图1b、1c)。

1.2.2 颞下颌关节间隙测量项目^[5] ①A:关节前间隙距,过髁状突前缘切点(a点)作L3的垂线与关节窝的交点,该交点与a点的距离;②P:关节后间隙距,过髁状突后缘切点(b点)作L4的垂线与关节窝的交点,该交点与b点的距离;③C:关节上间隙距,L2线上髁突交点与关节窝上缘点(o点)连线的距离(见图2)。

1.3 统计学分析

使用SPSS21.0软件进行统计分析,采用配对t检验分析前牵引矫治前后颌面部及颞下颌关节的变化情况,计量资料使用均数 $\pm$ 标准差表示, $\alpha =$

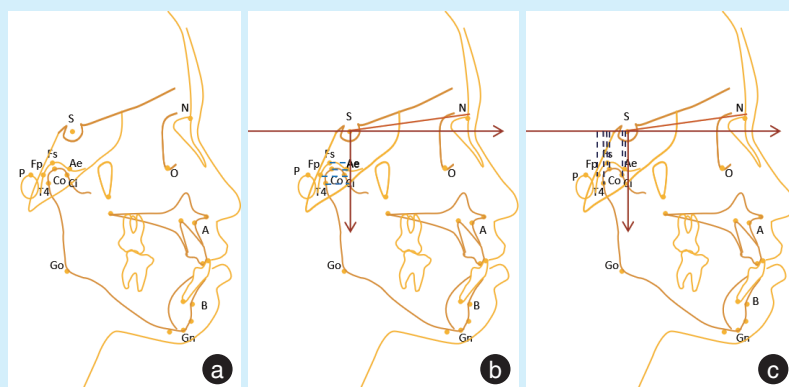
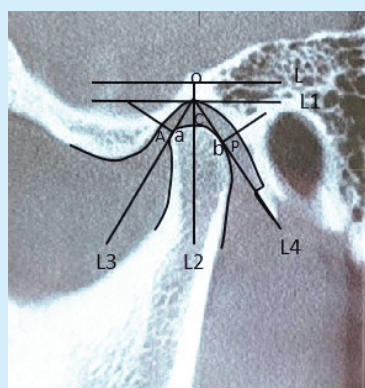


Figure 1 Landmark and measurement method of craniofacial

图1 颅面部的定点及测量方法



L: horizontal line; L1: parallel to the horizontal line tangent to L and the upper edge of the articular fossa; L2: the vertical line perpendicular to L1 through the tangent point of the upper edge of the articular fossa; L3: tangent line passing through the tangent point of the upper edge of the articular fossa and the tangent point of the front edge of the condyle; L4: tangent line passing through the tangent point of the upper edge of the joint fossa and the tangent point of the posterior edge of the condyle; O: intersection of L line (horizontal line) and L2 line (vertical line); a: the tangent point between L3 line and the front edge of condyle; b: The tangent point between L4 line and the posterior edge of condyle; A: distance of anterior joint space; P: distance of posterior joint space; C: distance of superior joint space

Figure 2 Measurement items of temporomandibular joint space

图2 颞下颌关节间隙测量项目

0.05。采用 Pearson 相关分析对前牵引矫治后颌面部头影测量指标和颞下颌关节测量值之间的线性相关程度进行分析, $\alpha=0.05$ 。

2 结果

2.1 治疗前后颌面部头影测量指标改变

前牵引治疗前后骨骼发生明显改变, 治疗后蝶鞍点-鼻根点-上齿槽座点角 (sella-nasion-subspinale angle, SNA)、ANB 明显增大, 分别增加 $3.57^\circ \pm 2.62^\circ$ ($P < 0.001$)、 $3.97^\circ \pm 2.32^\circ$ ($P < 0.001$)。下领的方向也发生改变, 治疗后 GoGn 连线与 SN 连线的交角 (gonion-gnathion line and sella-nasion line angle, MP-SN) 增加 $1.02^\circ \pm 3.90^\circ$ ($P = 0.003$)。前牵引后上前牙突度明显增大, 上中切牙长轴与 SN 平面相交的交角 (upper incisor and sella-nasion line angle, U1-SN) 增加 $4.97^\circ \pm 5.51^\circ$ ($P < 0.001$)。下前牙突度明显减小, 下中切牙长轴与 GoGn 连线的交角 (lower incisor and gonion-gnathion line angle, L1-MP) 减小 $1.26^\circ \pm 1.41^\circ$ ($P = 0.008$), 见表 1。

2.2 治疗前后颞下颌关节改变

关节窝的坐标系指标改变: 在 X 轴上, 仅关节窝后缘点 Fp 到 S 点的距离 (S-Fpx) 发生改变, 减少 $(0.16 \pm 1.52) \text{ mm}$ ($P = 0.041$), 即前牵引矫治后关节窝前缘、上缘无明显改变, 仅后缘的位置发生前移; 在 Y 轴上, 关节窝位置均无显著改变 ($P > 0.05$), 即前牵引矫治后关节窝位置无垂直方向上改变。

髁状突的坐标系指标改变为: 在 X 轴上, 髁状突前缘点 Ci ($P = 0.333$)、上缘点 Co ($P = 0.405$) 及后缘点 T4 ($P = 0.225$) 位置改变均无显著性差异, 说明前牵引矫治后髁状突位置无前后向移动改变。在 Y 轴上, 髁状突后缘点 T4、上缘点 CO 位置改变均无显著性差异, 仅髁状突前缘距离 (即 S 点到 Ci 点在 Y 轴向的距离, S-Ciy) 明显减小 $(0.09 \pm 2.03) \text{ mm}$ ($P = 0.028$), 说明在垂直方向上, 前牵引矫治后髁状突前缘位置下移, 而髁状突的上缘及后缘的位置无显著改变。

颞下颌关节间隙的坐标系指标改变为: 关节前间隙 (A) 有增加 ($P = 0.358$), 关节上间隙 (P)

表1 前牵引治疗前后测量值比较

Table 1 Comparison of measurements before and after maxillary protraction treatment

 $\bar{x} \pm s$

	Pre-treatment	Post-treatment	Changes	<i>t</i>	<i>P</i>
SNA/°	79.98 ± 4.02	83.55 ± 3.78	3.57 ± 2.62	4.064	< 0.001
SNB/°	81.52 ± 3.69	81.38 ± 3.90	-0.14 ± 2.55	-0.404	0.689
ANB/°	-1.74 ± 1.73	2.23 ± 1.34	3.97 ± 2.32	3.795	< 0.001
U1-SN/°	110.78 ± 6.01	115.57 ± 7.83	4.97 ± 5.51	4.369	< 0.001
L1-MP/°	79.12 ± 15.21	77.86 ± 4.33	-1.26 ± 1.41	-0.736	0.008
MP-SN/°	38.79 ± 6.18	39.81 ± 5.94	1.02 ± 3.90	1.269	0.003
FH-MP/°	32.55 ± 6.07	33.33 ± 6.04	-0.78 ± 3.90	-1.521	0.139
S-Aex/mm	1.66 ± 2.89	1.72 ± 2.96	0.06 ± 1.51	0.158	0.471
S-Fsx/mm	13.04 ± 2.98	13.22 ± 2.90	0.19 ± 1.55	0.914	0.294
S-Fpx/mm	18.47 ± 2.87	18.41 ± 2.93	-0.16 ± 1.52	-1.106	0.041
S-Aey/mm	23.86 ± 3.18	23.78 ± 3.03	-0.08 ± 3.18	-1.028	0.289
S-Fsy/mm	24.62 ± 3.25	24.44 ± 3.03	-0.19 ± 3.19	-0.208	0.095
S-Fpy/mm	24.14 ± 3.31	24.21 ± 2.84	0.08 ± 2.93	0.278	0.128
S-T4x/mm	15.51 ± 3.19	15.69 ± 3.29	0.18 ± 1.49	0.136	0.333
S-Cox/mm	14.01 ± 3.22	13.99 ± 3.67	-0.02 ± 1.67	-0.355	0.405
S-Cix/mm	5.76 ± 2.86	5.77 ± 2.88	0.01 ± 1.58	0.990	0.225
S-T4y/mm	28.65 ± 3.14	28.89 ± 3.25	0.24 ± 2.90	-1.809	0.377
S-Coy/mm	24.09 ± 3.42	24.67 ± 3.66	0.58 ± 2.98	0.158	0.150
S-Ciy/mm	26.76 ± 2.74	27.67 ± 2.68	-0.09 ± 2.03	-0.914	0.028
A/mm	2.78 ± 0.70	2.83 ± 0.79	0.04 ± 0.86	0.0659	0.358
P/mm	3.83 ± 0.96	3.56 ± 0.86	-0.28 ± 1.22	-0.895	0.120
C/mm	3.70 ± 1.02	3.69 ± 0.94	-0.03 ± 1.41	-0.127	0.496

SNA: sella-nasion-subspinale angle; SNB: sella-nasion-supramental angle; ANB: subspinale -nasion-supramental angle; U1-SN: upper incisor and sella-nasion line angle; L1-MP: lower incisor and gonion-gnathion line angle; MP-SN: gonion-gnathion line and sella-nasion line angle GoGn; FH-MP: orbitale -porion line and gonion-gnathion line angle; S-Aex: sella to Ae distance on the X-axis; S-Fsx: sella to Fs distance on the X-axis; S-Fpx: sella to Fp distance on the X-axis; S-T4x: sella to T4 distance on the X-axis; S-Cox: sella to Co distance on the X-axis; S-Cix: sella to Ci distance on the X-axis; S-Aey: sella to Ae distance on the Y-axis; S-Fsy: sella to Fs distance on the Y-axis; S-Fpy: sella to Fp distance on the Y-axis; S-T4y: sella to T4 distance on the Y-axis; S-Coy: sella to Co distance on the Y-axis; S-Ciy: sella to Ci distance on the Y-axis; A: distance of anterior joint space; P: distance of posterior joint space; C: distance of superior joint space

($P = 0.120$)、关节后间隙(C)($P = 0.496$)减小,但均无显著性差异(表1)。

2.3 治疗后头影测量指标与颞下颌关节指标的Pearson相关分析

对治疗后头影测量指标与颞下颌关节指标进行Pearson相关分析,发现在X轴方向,关节窝的前缘($r = -0.633, P = 0.001$)、上缘($r = -0.451, P = 0.031$)、后缘($r = -0.537, P = 0.008$)位置均与蝶鞍点-鼻根点-下齿槽座点角(sella-nasion-supramental angle, SNB)呈中等负相关;髁状突的前缘($r = -0.507, P = 0.007$)、上缘($r = -0.445, P = 0.033$)、后缘($r = -0.543, P = 0.014$)也均与SNB呈中等负相关关系;关节窝的后缘与U1-SN呈中等负相关($r = -0.427, P = 0.042$)。在Y轴方向,关节窝和髁状突的前缘、上缘、后缘均与OP连线和GoGn连线的交角(orbitale -porion line and Go-Gn line angle, FH-MP)呈中等正相关;关节窝后缘与ANB为中等正相关($r = 0.549, P = 0.007$);髁状突的前缘与ANB有中等正相关($r = 0.425, P = 0.043$)。治疗后的关节间隙的相关性分析发现,关节前间隙、后

间隙和关节上间隙与牙颌面部头影测量指标均无相关性(表2)。

3 讨论

前牵引矫治青少年骨性Ⅲ类错骀的作用原理是通过牵张上颌各个未完全闭合的骨缝使之生长扩大^[6],且在颌面部发育的第二个高峰期即混合牙列期前牵引骨改建的效应较明显^[7]。然而对于错过颌骨发育高峰期的恒牙早期青少年骨性Ⅲ类错骀患者采用前牵引治疗时,是否会因为骨改建效能的降低导致颞下颌关节力载过大,进而引发颞下颌关节结构及功能的改变目前尚未明确。本文通过分析前牵引后颌颌面组织与颞下颌关节的相关关系,探讨前牵引矫治对青少年颞下颌关节结构的影响。

3.1 治疗前后颌颌面组织及颞下颌关节的改变

前牵引矫治前后恒牙早期患者的改变有:骨性关系达到Ⅰ类,上下颌前牙代偿加重,下颌的顺时针旋转。在骨骼方面,恒牙早期患者的前牵引治疗可达到纠正骨性Ⅲ类的治疗效果,与Buyukca-

表2 治疗后头影测量指标与颞下颌关节指标的相关性分析 r 值Table 2 Correlation analysis between cephalometry measurements and temporomandibular joint measurements (r value)

	S-Aex	S-Fsx	S-Fpx	S-T4x	S-Cox	S-Cix	S-Aey	S-Fsy	S-Fpy	S-T4y	S-Coy	S-Ciy	A	P	C
SNA	-0.510*	-0.315	-0.438*	-0.420*	-0.347	-0.453*	-0.055	0.243	0.246	0.283	0.166	0.020	-0.067	0.098	0.077
SNB	-0.633**	-0.451*	-0.537**	-0.543**	-0.445*	-0.507*	-0.194	0.147	-0.010	0.167	0.032	-0.198	-0.010	0.034	0.056
ANB	0.217	0.222	0.153	0.203	0.178	0.083	0.239	0.215	0.549**	0.250	0.283	0.425*	-0.096	0.160	0.085
U1-SN	-0.372	-0.334	-0.427*	-0.389	-0.280	-0.412	0.147	0.411	0.231	0.265	0.308	0.007	-0.274	0.082	-0.055
L1-MP	0.324	0.131	0.239	0.284	0.169	0.206	-0.116	-0.163	0.098	-0.210	-0.030	0.139	0.024	-0.037	-0.123
MP-SN	0.077	0.211	0.162	0.120	0.157	0.131	0.489*	0.419*	0.341	0.446*	0.373	0.368	0.047	0.114	0.178
FH-MP	-0.176	0.110	-0.053	-0.078	-0.009	-0.040	0.524*	0.610**	0.474*	0.635**	0.529**	0.424*	0.043	0.251	0.249

*: $P < 0.05$; **: $P < 0.01$; SNA: sella-nasion-subspinale angle; SNB: sella-nasion-supramental angle; ANB: subspinale-nasion-supramental angle; U1-SN: upper incisor and sella-nasion line angle; L1-MP: lower incisor and gonion-gnathion line angle; MP-SN: gonion-gnathion line and sella-nasion line angle; GoGn: FH-MP: orbitale -porion line and gonion-gnathion line angle; S-Aex: sella to Ae distance on the X-axis; S-Fsx: sella to Fs distance on the X-axis; S-Fpx: sella to Fp distance on the X-axis; S-T4x: sella to T4 distance on the X-axis; S-Cox: sella to Co distance on the X-axis; S-Cix: sella to Ci distance on the X-axis; S-Aey: sella to Ae distance on the Y-axis; S-Fsy: sella to Fs distance on the Y-axis; S-Fpy: sella to Fp distance on the Y-axis; S-T4y: sella to T4 distance on the Y-axis; S-Coy: sella to Co distance on the Y-axis; S-Ciy: sella to Ci distance on the Y-axis; A: distance of anterior joint space; P: distance of posterior joint space; C: distance of superior joint space

vus 等^[8]对平均年龄为 (11.4 ± 1.06) 岁骨性Ⅲ类错殆患者前牵引治疗的结果相同。在牙殆方面,恒牙早期骨性Ⅲ类患者本身就存在上前牙唇倾、下前牙舌倾的临床表现,在前牵引治疗后上前牙的唇倾和下前牙的舌倾加重^[9],这与 Matsumoto 等^[10]采用骨支抗前牵引治疗青春生长发育高峰后期患者的结果相同。在面部生长方向上,青少年患者前牵引治疗后下颌发生下旋,与 Miranda 等^[11]的前牵引治疗结果相一致。关节窝的矫治前后改变为关节窝前缘、上缘位置无明显改变,仅后缘发生前移。关节窝作为下颌骨的后界,Noh 等^[12]认为关节窝前位是Ⅲ类错殆下颌前突的解剖特征之一;Yassa 等^[13]发现关节窝的宽度与患颞下颌关节紊乱病的机率相关。因此认为前牵引治疗后关节窝后缘位置的前移,不利于Ⅲ类颌骨关系的改善及颞下颌关节的功能协调。

本研究发现矫治后仅髁状突前缘位置发生上移,且平均位移量很小,这说明前牵引矫治对髁状突位置有影响。矫治后颞下颌关节前间隙、上间隙、后间隙的改变均无显著性差异,因此认为前牵引矫治不会导致关节间隙发生变化。骨性Ⅲ类患者颞下颌关节间隙的特点为关节前间隙较小,关节后间隙较大,关节盘位于髁突的稍前方^[14]。本研究发现治疗后关节间隙没有发生改变,说明前牵引治疗并不会改变关节原有的盘-窝-突关系。因此从维持青少年关节结构的稳定性来说,前牵引治疗是安全的。

3.2 前牵引治疗后颞下颌关节改变的相关性分析

本研究在对前牵引治疗后关节窝位置与殆颌面组织结构之间的相关性进行分析时发现,在矢

状向(X轴),关节窝的位置以及髁状突的位置均与SNB呈中等负相关关系,说明治疗后的关节窝及髁状突的位置越偏前,下颌越前突。Rivero-Millán 等^[15]也认为髁状突的位置影响下颌位置。同时,关节窝的后缘与U1-SN呈负相关,说明治疗后的上前牙越唇倾,关节窝的后缘可能会越向前。所以认为前牵引后关节窝后缘的前移与下颌突度及前牙切导情况有一定关系。

研究表明,前牵引治疗后下颌骨发生顺时针旋转^[16]。本研究发现,关节窝和髁状突的垂直向(Y轴)位置均与FH-MP呈中等正相关,即治疗后关节窝和髁状突的位置越靠下,下颌越下旋。Lee 等^[17]在研究前牵引矫治后颞下颌关节的三维变化中也证实,是髁突点的改变使下颌发生了顺旋。Nindra 等^[18]认为髁状突的重塑可以改善上颌骨-下颌骨间的关系,与本研究髁状突的前缘位置与ANB之间呈中等正相关结果一致。总之,前牵引治疗后髁状突前缘发生向上的骨改建,与上下颌骨矢状关系及垂直关系均有一定关系。但是以上相关关系非密切相关关系,即前牵引治疗对颞下颌关节有影响,但无直接影响。此结论与正畸治疗对颞下颌关节影响的观点相一致^[19]。治疗后的关节间隙的相关性分析发现,关节前间隙、后间隙和关节上间隙与牙颌面部头影测量指标均无相关性。说明前牵引治疗后殆颌面的改变不会引起关节间隙的改变。关节间隙的变化一直是颞下颌疾病诊断治疗的重要指标,因此认为前牵引治疗与颞下颌疾病的发生没有相关性。

综上所述,本研究发现,青少年的前牵引治疗对关节窝及髁状突改建有一定影响,但对关节间

隙没有影响。前牵引治疗后,颞下颌关节在矢状向及垂直向的位移与上下颌骨矢状关系及下颌突度都具有相关关系。以上结果提示临床医师既要关注前牵引治疗过程中对青少年颞下颌关节的影响,同时也要重视治疗前对青少年骨性Ⅲ类患者颞下颌关节问题的筛查。

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