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·临床研究·

不同矢状向骨性错殆患者的舌骨位置比较

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【摘要】 目的 比较三类矢状向骨性错殆患者的舌骨位置差异，为临床治疗提供参考。**方法** 选取284例正畸患者的头颅侧位片，根据ANB角大小确定患者的矢状向骨性错殆类型：骨性Ⅰ类（1°≤ANB≤5°）、Ⅱ类（ANB>5°）、Ⅲ类（ANB<1°）；使用10项指标确定舌骨位置；比较三类患者的舌骨位置并基于性别和年龄进行分层分析。**结果** 骨性Ⅰ类、Ⅱ类和Ⅲ类患者的人口学和垂直面型特征差异均无统计学意义（$P>0.05$）。骨性Ⅱ类患者的下颌角点-舌骨点连线与舌骨点-颏下点连线的夹角（angle between Gonion-hyoid point line and hyoid point-Menton line, Go-Hy-Me）小于Ⅰ类患者，Ⅲ类患者的第三颈椎最前下点-舌骨点连线与舌骨点-蝶鞍点连线的夹角（angle between most anterior and inferior point of third cervical vertebra-hyoid point line and hyoid point-Sella line, C3-Hy-S）小于Ⅰ类患者（$P<0.05$）。年龄分层分析显示，未成年群体中，男性及女性Ⅲ类患者的C3-Hy-S均小于Ⅰ类患者（$P<0.05$）。成年群体中，女性Ⅱ类患者的Go-Hy-Me小于Ⅰ类患者，舌骨点至下颌平面的距离（distance from hyoid point to mandibular plane, Hy-MP）大于Ⅰ类患者（$P<0.05$），男性Ⅱ类患者的舌骨位置与Ⅰ类患者差异无统计学意义（$P>0.05$）。**结论** 成年女性骨性Ⅱ类患者比Ⅰ类患者的舌骨更远离下颌；未成年骨性Ⅲ类患者比Ⅰ类患者的舌骨更远离颈椎与后颅底。

【关键词】 骨性错殆；骨性Ⅰ类；骨性Ⅱ类；骨性Ⅲ类；矢状向面型；正畸；舌骨；下颌骨；头影测量
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Comparison of hyoid bone positions among patients with different sagittal skeletal malocclusions

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【Abstract】 Objective To compare the hyoid bone position among patients with different sagittal skeletal malocclusions to provide a reference for clinicians to formulate treatment plans. **Methods** Lateral cephalograms of 284 orthodontic patients were selected. According to ANB angles, the types of skeletal malocclusion of patients were determined as follows: Class Ⅰ (1°≤ANB≤5°), Class Ⅱ (ANB>5°) and Class Ⅲ (ANB<1°). Ten parameters were used to determine hyoid positions. After comparing the hyoid positions of the three groups, stratified analyses based on sex and age were conducted. **Results** No significant differences in demographic and vertical facial type features among skeletal Classes Ⅰ, Ⅱ and Ⅲ patients were observed ($P>0.05$). The angle between the Gonion-hyoid point line and the hyoid point-Menton line (Go-Hy-Me) of Class Ⅱ patients was significantly smaller than that of Class Ⅰ patients, and the angle between the most anterior and inferior point of the third cervical vertebra-hyoid point line and the hyoid point-Sella line (C3-Hy-S) of Class Ⅲ patients was smaller than that of Class I patients ($P<0.05$). Age-stratified analysis showed

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that in the juvenile group, the C3-Hy-S of Class Ⅲ patients was significantly smaller than that of Class Ⅰ patients in males and females ($P < 0.05$). In the adult female group, the Go-Hy-Me of Class Ⅱ patients was significantly smaller, and the distance from the hyoid point to the mandibular plane (Hy-MP) was larger than that noted in Class Ⅰ patients ($P < 0.05$); no significant difference in hyoid position between male Class Ⅱ and I patients was observed ($P > 0.05$). **Conclusions** Compared with Class Ⅰ patients, the hyoid bone of Class Ⅱ patients in adult females was farther away from the mandible and that of Class Ⅲ patients in juveniles was farther away from the cervical vertebra and posterior cranial base.

【Key words】 skeletal malocclusion; skeletal Class Ⅰ; skeletal Class Ⅱ; skeletal Class Ⅲ; sagittal facial type; orthodontics; hyoid bone; mandibular bone; cephalometry

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舌骨处于头颈部中心位置，参与构成口颌面部复合体，在吞咽、发音、呼吸等多种生理功能中均具有重要作用。由于舌骨是头颈部唯一一块不与其他骨骼直接相连的骨，其位置容易受到周围结构的影响，特别是下颌骨。例如正颌手术调整颌骨位置后可引起舌骨位置的适应性改变[1]。舌骨位置的变化也可能对相邻解剖结构产生一定影响。研究表明舌骨位置与咽部气道容积、颞下颌关节紊乱病的发生均有关联[2-3]。课题组前期研究还发现，舌骨位置与颞下颌关节髁突骨质相关[4]。以上研究提示舌骨位置差异可能改变气道大小、颞下颌关节负荷，从而影响患者口颌系统功能，需引起临床医生重视。

确定不同面型患者的舌骨位置用于评估其口颌系统状态，有助于确定合理的治疗方案。已有研究报道波斯民族中不同矢状面型人群的舌骨位置存在不同[5]；不同垂直面型的汉族人群其舌骨位置也有差异[6]。然而，汉族中不同矢状面型人群的舌骨位置的具体差异仍不清楚。因此，本研究通过比较骨性Ⅰ类、Ⅱ类和Ⅲ类错𬌗患者的舌骨位置并进行年龄分层分析，初步探讨不同性别与年龄的人群中舌骨位置差异模式是否一致。

1　资料和方法

1.1　研究对象

招募2021年6月至9月期间就诊于四川大学华西口腔医院正畸科的患者。纳入标准：①首次接受正畸治疗；②依从性好，自愿参加研究；③汉族；④年龄≥12岁；⑤具有高质量、显示第四颈椎的头颅侧位片。排除标准：①正畸或正颌手术治疗史；②头颈部肿瘤、外伤史；③颅面与脊柱先天与后天畸形；④严重牙体牙髓、牙周、口腔黏膜疾病；⑤牙齿数量异常；⑥全身系统性疾病。本研究已获得了四川大学华西口腔医院伦理委员会的批准（审批号：WCHSIRB-D-2021-431）。未成年患者的监护人与成年患者均签署了知情同意书。

1.2　头影测量分析

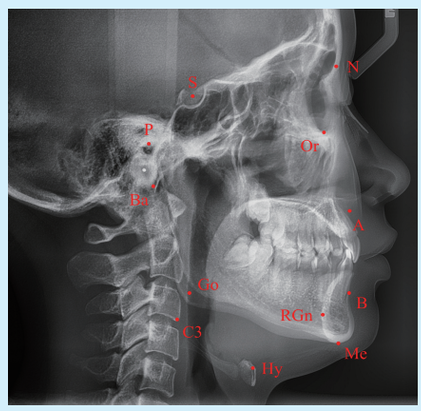
患者的头颅侧位片均于四川大学华西口腔医院医学影像科采用同一台仪器进行拍摄。拍摄时，要求患者头部处于自然头位、下颌位于牙尖交错位、不能吞咽。头颅侧位片拍摄后于医学影像科数据库中进行收集。Uceph软件（牙迅，中国）用于头影测量分析。图1展示了头影测量标志点。头影测量指标包括ANB角、眶耳平面-下颌平面角（Frankfort-mandibular angle，FMA）和10项舌骨位置测量值（7项线性测量值和3项角度测量值）[3,6]。根据ANB角大小，将患者分为骨性Ⅰ类（1°≤ANB≤5°）、骨性Ⅱ类（ANB > 5°）和骨性Ⅲ类（ANB < 1°）[7]。根据FMA角正常值范围，确定每位患者的垂直面型：低角型（FMA < 18.5°）、均角型（18.5°≤FMA≤28°）、高角型（FMA > 28°）[8]。舌骨位置线性测量值包括：①Hy-Ba，舌骨体最前上点（舌骨点）至颅底点的距离，代表舌骨相对于后颅底的位置；②Hy-RGn，舌骨点至颏后部最后点的距离，代表舌骨相对于颏部的位置；③Hy-C3，舌骨点至第三颈椎最前下点的距离，代表舌骨相对于第三颈椎的位置；④Hy-FH，舌骨点至眶耳平面（眶点-耳点连线）的垂直距离，代表舌骨的垂直位置；⑤Hy-MP，舌骨点至下颌平面（颏下点-下颌角点连线）的垂直距离，代表舌骨相对于下颌骨的位置；⑥Hy-

C3RGn，舌骨点至第三颈椎最前下点-颏后部最后点连线的垂直距离，代表舌骨相对于下颌骨的位置及垂直位置；⑦C3-RGn，第三颈椎最前下点至颏后部最后点的距离，代表颏部与颈椎的相对位置。舌骨位置角度测量值包括：①Go-Hy-Me，下颌角点-舌骨点连线与舌骨点-颏下点连线的夹角，代表舌骨相对于下颌骨的位置；②Hy-C3-S，舌骨点-第三颈椎最前下点连线与第三颈椎最前下点-蝶鞍点连线的夹角，代表舌骨相对于后颅底的位置；③C3-Hy-S，第三颈椎最前下点-舌骨点连线与舌骨点-蝶鞍点连线的夹角，代表舌骨相对于后颅底及颈椎的位置。

在未知患者其他信息的情况下，两位研究者共同进行了头影测量分析。评价研究者内部测量一致性时，每位研究者选取20张头颅侧位片进行首次测量，一个月后重复测量；评价研究者之间测量一致性时，选取20张头颅侧位片由两位研究者同时测量。组内相关系数（intraclass correlation coefficient, ICC）用于评价测量可靠性。研究者内部的ICC分别为0.82~0.88、0.84~0.91，两位研究者之间的ICC为0.77~0.84。结果显示测量可靠性较高。

1.3　统计学分析

使用SPSS 20.0软件进行统计学分析。Shapiro-Wilk检验判断定量数据是否呈正态分布，当数据呈正态分布时，用均值±标准差描述，组间比较采用单因素方差分析；当数据不呈正态分布时，用中位数与上下四分位数表示，组间比较采用Kruskal-Wallis H检验。定性数据采用数量与频率表示，组间比较采用χ^2检验。$P<0.05$为差异有统计学意义。



N: nasion; S: sella; P: porion; Or: orbitale; Ba: basion; A: subspinale; B: supramentale; Me: menton; Go: gonion; Hy: most anterior and superior point on the body of hyoid bone; RGn: most protrusive point of retrognathion; C3: most anterior and inferior point of third cervical vertebra

Figure 1　Cephalometric landmarks

图1　头影测量标志点

2　结　果

2.1　整体分析

本研究共纳入284例正畸患者，男性108例（38.0%），女性176例（62.0%），平均年龄（20.93±7.06）岁。其中骨性Ⅰ类患者98例（34.5%），Ⅱ类患者100例（35.2%），Ⅲ类患者86例（30.3%）；三类患者的年龄、性别和垂直面型分布差异均无统计学意义（$P>0.05$，表1）。

表1　不同骨性错𬌗患者的人口学和垂直面型特征

Table 1　Demographic and vertical facial type characteristics of patients with different skeletal malocclusions　*n* (%)

Item		Skeletal Class Ⅰ (n = 98)	Skeletal Class Ⅱ (n = 100)	Skeletal Class Ⅲ (n = 86)	H/χ^2	P
Age [year, median(P_{25}, P_{75})]		19.13(14.71, 26.27)	21.50(15.04, 26.69)	18.79(16.65, 23.42)	1.964	0.375
Gender	Male	37 (37.8)	34 (34.0)	37 (43.0)	1.602	0.449
	Female	61 (62.2)	66 (66.0)	49 (57.0)		
Vertical facial type	Low-angle	23 (23.5)	20 (20.0)	21 (24.4)		
	Average-angle	55 (56.1)	45 (45.0)	45 (52.3)	6.152	0.188
	High-angle	20 (20.4)	35 (35.0)	20 (23.3)		

骨性Ⅱ类患者的Go-Hy-Me角小于其他两类患者，Hy-C3-S角小于Ⅲ类患者，差异有统计学意义（$P<0.05$，表2）；骨性Ⅲ类患者的Hy-RGn和C3-RGn距离大于其他两类患者，C3-Hy-S角小于Ⅰ类患者（$P<0.05$）。男性群体中，骨性Ⅲ类患者的C3-RGn大于其他两类患者（$P<0.05$）。女性群体中，C3-RGn在三组患者间差异均有统计学意义（$P<0.05$）；骨性Ⅱ类患者的Hy-MP距离大于Ⅰ类患者，Go-Hy-Me小于Ⅰ类患者；骨性Ⅲ类患者的Hy-RGn大于其他两类患者，C3-Hy-S小于其他两类患者

表2　不同骨性错𬌗患者的舌骨位置

Table 2　Hyoid bone positions of patients with different skeletal malocclusions　$\bar{x} \pm s$/Median (P_{25}, P_{75})

Item	Skeletal Class Ⅰ (n = 98)	Skeletal Class Ⅱ (n = 100)	Skeletal Class Ⅲ (n = 86)	F/H	P
Hy-Ba/mm	74.00(69.08, 81.15)	73.28(68.04, 79.43)	76.45(71.16, 82.56)	5.964#	0.051
Male	81.08 ± 7.87	79.24 ± 7.06	83.17 ± 6.88	2.590	0.080
Female	71.68 ± 5.91	70.98 ± 6.05	72.12 ± 7.99	0.444	0.642
Hy-RGn/mm	33.78 ± 4.77[a]	32.74 ± 4.99[a]	36.73 ± 5.06[b]	15.928	< 0.001
Male	34.92 ± 4.88	34.79 ± 5.30	37.21 ± 5.59	2.425	0.093
Female	33.09 ± 4.61[a]	31.69 ± 4.51[a]	36.37 ± 4.65[b]	15.020	< 0.001
Hy-C3/mm	32.84(30.63, 36.55)	33.16(29.73, 36.90)	34.09(30.62, 37.84)	2.056#	0.358
Male	36.95 ± 4.21	36.81 ± 4.52	37.85 ± 4.85	0.557	0.574
Female	30.96(29.56, 33.31)	31.79(28.99, 33.94)	31.91(28.79, 34.60)	0.329#	0.848
Hy-FH/mm	83.91(78.11, 91.03)	85.71(80.22, 90.70)	85.16(78.84, 90.28)	0.362#	0.834
Male	92.20 ± 7.55	92.20 ± 7.35	92.07 ± 7.13	0.004	0.996
Female	80.64(77.43, 84.56)	82.07(78.94, 86.43)	79.70(76.19, 84.31)	5.149#	0.076
Hy-MP/mm	12.89(9.17, 15.66)	14.59(10.81, 17.93)	13.69(10.16, 17.62)	5.100#	0.078
Male	15.38 ± 5.51	16.47 ± 5.29	15.15 ± 5.93	0.559	0.574
Female	11.19(7.79, 14.69)[a]	12.73(10.60, 16.57)[b]	12.74(8.69, 15.71)[ab]	7.136#	0.028
Hy-C3RGn/mm	0.16 ± 9.18	7.91 ± 5.02	6.85 ± 6.10	1.176	0.310
Male	1.10 ± 11.77	10.86 ± 4.85	8.53 ± 5.52	1.663	0.194
Female	−0.40 ± 7.22	6.40 ± 4.42	5.58 ± 6.25	1.411	0.247
C3-RGn/mm	65.04 ± 7.02[a]	63.31 ± 6.87[a]	68.92 ± 7.29[b]	15.129	< 0.001
Male	67.90 ± 8.16[a]	67.47 ± 7.50[a]	72.28 ± 7.90[b]	4.163	0.018
Female	63.30 ± 5.63[a]	61.22 ± 5.46[b]	66.39 ± 5.66[c]	12.077	< 0.001
Go-Hy-Me/°	138.96 ± 17.20[a]	131.54 ± 14.95[b]	136.78 ± 15.49[a]	5.676	0.004
Male	133.12 ± 15.50	128.51 ± 14.97	134.97 ± 15.95	1.619	0.203
Female	142.98(131.73, 154.25)[a]	135.70(125.17, 143.68)[b]	137.94(128.14, 151.27)[ab]	10.451#	0.005
Hy-C3-S/°	91.39 ± 11.68[ab]	89.88 ± 10.47[a]	93.96 ± 11.63[b]	3.086	0.047
Male	94.55 ± 11.48	91.40 ± 9.77	95.06 ± 9.01	1.333	0.268
Female	89.47 ± 11.47	88.69 ± 10.46	93.14 ± 13.31	2.230	0.111
C3-Hy-S/°	95.44(91.24, 101.86)[a]	94.99(84.87, 99.56)[ab]	92.13(82.39, 98.12)[b]	11.644#	0.003
Male	102.70(95.90, 107.29)	98.56(76.13, 105.64)	98.87(66.97, 106.51)	4.267#	0.118
Female	93.05(90.04, 107.50)[a]	94.62(88.89, 96.95)[a]	89.50(83.32, 93.28)[b]	12.801#	0.002

#: Kruskal-Wallis H test was used. a, b, c: the same letters indicate no statistically significant difference, and different letters indicate significant differences between groups. Hy-Ba: distance between most anterior and superior point on the body of hyoid bone (Hy) and Basion; Hy-RGn: distance between Hy and most protrusive point of retrognathion (RGn); Hy-C3: distance between Hy and most anterior and inferior point of third cervical vertebra (C3); Hy-FH: vertical distance from Hy to Frankfort horizontal plane; Hy-MP: vertical distance from Hy to mandibular plane; Hy-C3RGn: vertical distance from Hy to C3-RGn line; C3-RGn: distance between C3 and RGn; Go-Hy-Me: angle between Gonion-Hy line and Hy-Menton line; Hy-C3-S: angle between Hy-C3 line and C3-Sella line; C3-Hy-S: angle between C3-Hy line and Hy-Sella line

($P < 0.05$)。

2.2　基于年龄的分层分析

将全体患者分为未成年(年龄 < 18岁)和成年(年龄≥18岁)群体后进行分层分析。未成年群体中,骨性Ⅱ类患者的Go-Hy-Me小于其他两类患者($P < 0.05$,表3);骨性Ⅲ类患者的Hy-RGn大于Ⅰ类患者,C3-Hy-S小于其他两类患者($P < 0.05$)。未成年男性群体中,骨性Ⅲ类患者的C3-Hy-S小于其他两类患者($P < 0.05$)。未成年女性群体中,骨性Ⅱ类患者的C3-RGn小于Ⅲ类患者;骨性Ⅲ类患者的Hy-RGn大于Ⅰ类患者,C3-Hy-S小于Ⅰ类患者($P < 0.05$)。

成年群体中,Hy-RGn在三组患者之间的差异有统计学意义($P < 0.05$,表4);骨性Ⅲ类患者的Hy-Ba距离大于Ⅱ类患者,骨性Ⅲ类患者的C3-RGn大于其他两类患者($P < 0.05$)。成年男性群体中,未发现三组患者之间的舌骨位置差异($P > 0.05$)。成年女性群体中,仍观察到Hy-RGn和C3-RGn在

表3　未成年群体中不同骨性错𬌗患者的舌骨位置

Table 3　Hyoid bone positions of juvenile patients with different skeletal malocclusions　　$\bar{x} \pm s$/Median (P_{25}, P_{75})

Item	Skeletal Class Ⅰ (n = 42)	Skeletal Class Ⅱ (n = 33)	Skeletal Class Ⅲ (n = 26)	F/H	P
Hy-Ba/mm	74.43 ± 6.78	71.50 ± 6.91	72.07 ± 8.21	1.734	0.182
Male	77.94 ± 7.51	77.14 ± 7.22	78.44 ± 4.51	0.087	0.917
Female	72.04 ± 5.11	68.28 ± 4.21	69.73 ± 8.07	2.392	0.100
Hy-RGn/mm	32.37(29.44,36.78)[a]	33.95(30.55,37.66)[ab]	37.08(32.95,39.39)[b]	6.668[#]	0.036
Male	34.02 ± 5.26	34.72 ± 6.45	35.34 ± 5.41	0.145	0.865
Female	31.99(29.39,34.45)[a]	32.85(30.99,36.51)[ab]	37.37(34.48,39.38)[b]	9.096[#]	0.011
Hy-C3/mm	32.69 ± 3.81	31.78 ± 4.74	32.46 ± 4.67	0.415	0.661
Male	35.07 ± 4.00	34.62 ± 5.52	37.02 ± 5.00	0.605	0.552
Female	31.08 ± 2.73	30.16 ± 3.39	30.78 ± 3.30	0.496	0.611
Hy-FH/mm	85.54 ± 8.07	84.43 ± 7.74	80.88 ± 7.72	2.897	0.060
Male	90.65 ± 7.84	90.30 ± 8.46	87.02 ± 7.22	0.549	0.583
Female	82.06 ± 6.25	81.08 ± 4.90	78.61 ± 6.73	1.833	0.169
Hy-MP/mm	13.99 ± 5.37	16.61 ± 5.79	13.86 ± 4.58	2.787	0.066
Male	14.87 ± 5.44	18.21 ± 6.27	14.10 ± 3.76	1.739	0.191
Female	13.39 ± 5.35	15.69 ± 5.44	13.77 ± 4.94	1.198	0.309
Hy-C3RGn/mm	−0.29 ± 8.59	8.69 ± 4.85	5.40 ± 6.23	2.930	0.058
Male	7.85 ± 4.63	11.51 ± 4.76	6.45 ± 6.31	2.830	0.073
Female	6.57 ± 4.83	7.08 ± 4.21	5.02 ± 6.33	0.869	0.424
C3-RGn/mm	63.02(58.54,68.92)	62.93(57.11,65.81)	65.34(61.28,70.22)	5.198[#]	0.074
Male	66.65 ± 8.48	64.68 ± 9.19	70.13 ± 10.40	0.793	0.461
Female	62.42(57.70,66.03)[ab]	62.78(57.11,64.55)[a]	65.24(61.29,69.69)[b]	7.131[#]	0.028
Go-Hy-Me/°	135.39 ± 15.82[a]	125.17 ± 16.89[b]	134.93 ± 13.67[a]	4.573	0.013
Male	132.43(120.29, 146.87)	118.32(108.97, 133.44)	132.47(129.54, 137.74)	5.135[#]	0.077
Female	136.41 ± 16.16	126.74 ± 17.18	134.41 ± 14.90	2.194	0.120
Hy-C3-S/°	91.73 ± 9.70	89.44 ± 10.15	92.90 ± 14.61	0.740	0.480
Male	91.22 ± 8.50	92.57 ± 10.68	93.86 ± 12.66	0.182	0.834
Female	92.08 ± 10.60	87.65 ± 9.64	92.54 ± 15.57	1.067	0.350
C3-Hy-S/°	96.90(91.01,103.16)[a]	93.20(89.78,100.54)[a]	84.22(71.72,92.70)[b]	19.350[#]	< 0.001
Male	102.80 ± 8.08[a]	97.79 ± 9.77[a]	84.11 ± 22.00[b]	5.724	0.007
Female	92.73(90.04,99.13)[a]	91.47(84.63,96.33)[ab]	84.10(74.27,92.20)[b]	12.049[#]	0.002

#: Kruskal-Wallis H test were used. a, b: the same letters indicate no statistically significant difference, and different letters indicate significant differences between groups. Hy-Ba: distance between most anterior and superior point on the body of hyoid bone (Hy) and Basion; Hy-RGn: distance between Hy and most protrusive point of retrognathion (RGn); Hy-C3: distance between Hy and most anterior and inferior point of third cervical vertebra (C3); Hy-FH: vertical distance from Hy to Frankfort horizontal plane; Hy-MP: vertical distance from Hy to mandibular plane; Hy-C3RGn: vertical distance from Hy to C3-RGn line; C3-RGn: distance between C3 and RGn; Go-Hy-Me: angle between Gonion-Hy line and Hy-Menton line; Hy-C3-S: angle between Hy-C3 line and C3-Sella line; C3-Hy-S: angle between C3-Hy line and Hy-Sella line

三类患者之间的差异有统计学意义($P < 0.05$)；骨性Ⅱ类患者的Hy-MP和Hy-C3RGn距离大于Ⅰ类患者，Go-Hy-Me小于Ⅰ类患者($P < 0.05$)。

3　讨　论

与其他两类患者相比，骨性Ⅱ类患者的C3-RGn与Hy-RGn距离均最小，反映出该类患者下颌骨明显后缩。在整体分析中，骨性Ⅱ类患者的Go-Hy-Me角较小、Hy-MP距离较大；成年女性群体中，仍观察到相同的结果；尽管在全体未成年人群中可见骨性Ⅱ类患者的Go-Hy-Me角较小，但经性别分层分析后未观察到类似差异。由此可见骨性Ⅱ类患者，尤其成年女性群体中的骨性Ⅱ类患者，舌骨离下颌骨较远。考虑到各类患者的Hy-C3距离差异无统计学意义，由此可认为骨性Ⅱ类患者的舌骨有向后下移动的趋势。既往研究表明，骨性Ⅱ类患者的舌骨水平位置较为靠后[5,9]，这与本研究的结果相似。舌骨位置变化可归因于附着于舌骨的软组织影响[9]，Ⅱ类患者下颌相对于上颌明显后缩，可通过肌肉韧带带动舌骨向后向下移动。未成年群体中Ⅱ类患者可能由于仍处于生长发育期，舌骨位置还受其他因素影响，尚未能表现出明

表4　成年群体中不同骨性错𬌗患者的舌骨位置

Table 4　Hyoid bone positions of adult patients with different skeletal malocclusions　　$\bar{x} \pm s$/Median (P_{25}, P_{75})

Item	Skeletal Class Ⅰ (n = 56)	Skeletal Class Ⅱ (n = 67)	Skeletal Class Ⅲ (n = 60)	F/H	P
Hy-Ba/mm	73.83(68.82, 82.28)^{ab}	74.64(68.19, 80.66)^{a}	78.03(72.59, 85.05)^{b}	6.402$^{\#}$	0.041
Male	83.76 ± 7.31	80.38 ± 6.86	84.27 ± 6.92	2.141	0.125
Female	70.17(67.10, 74.82)	71.73(67.05, 76.93)	72.74(69.00, 77.08)	1.468$^{\#}$	0.480
Hy-RGn/mm	34.07 ± 4.73^{a}	32.11 ± 4.93^{b}	36.94 ± 5.39^{c}	14.639	< 0.001
Male	35.69 ± 4.53	34.83 ± 4.73	37.64 ± 5.63	2.109	0.129
Female	33.17 ± 4.66^{a}	30.79 ± 4.50^{b}	36.23 ± 5.15^{c}	11.939	< 0.001
Hy-C3/mm	33.31(30.87, 39.29)	33.57(30.37, 37.24)	34.68(32.20, 38.60)	1.993$^{\#}$	0.369
Male	38.55 ± 3.77	38.00 ± 3.45	38.04 ± 4.88	0.115	0.892
Female	32.33 ± 3.69	32.12 ± 3.64	32.90 ± 3.79	0.404	0.668
Hy-FH/mm	83.72(78.02, 90.63)	86.05(80.71, 91.08)	87.35(80.31, 93.32)	2.228$^{\#}$	0.328
Male	93.51 ± 7.24	93.23 ± 6.65	93.24 ± 6.70	0.011	0.989
Female	80.50(77.05, 83.94)	82.58(79.09, 87.40)	80.38(76.22, 86.51)	4.891$^{\#}$	0.087
Hy-MP/mm	11.63(7.79, 14.93)	12.71(10.59, 16.90)	13.05(8.80, 17.75)	3.602$^{\#}$	0.165
Male	15.81 ± 5.67	15.53 ± 4.55	15.40 ± 6.35	0.031	0.969
Female	10.41(7.12, 13.16)^{a}	11.89(10.35, 16.46)^{b}	11.74(8.16, 14.77)^{ab}	7.382$^{\#}$	0.025
Hy-C3RGn/mm	6.26(2.01, 10.18)	7.58(4.47, 10.86)	6.71(4.00, 11.16)	2.247$^{\#}$	0.325
Male	11.93 ± 6.47	10.50 ± 4.97	9.01 ± 5.32	1.676	0.195
Female	3.82(−0.77, 6.57)^{a}	6.39(3.61, 9.00)^{b}	5.22(2.97, 8.73)^{ab}	6.873$^{\#}$	0.032
C3-RGn/mm	65.93 ± 7.06^{a}	63.66 ± 6.90^{a}	69.90 ± 7.19^{b}	12.606	< 0.001
Male	68.97 ± 7.93	68.98 ± 6.10	72.78 ± 7.32	2.474	0.092
Female	64.24 ± 6.00^{a}	61.06 ± 5.70^{b}	67.03 ± 5.87^{c}	9.601	< 0.001
Go-Hy-Me/°	141.64 ± 17.83	134.67 ± 12.92	137.58 ± 16.25	3.032	0.051
Male	132.46 ± 15.74	131.83 ± 13.15	134.65 ± 17.11	0.236	0.791
Female	146.75 ± 17.04^{a}	136.06 ± 12.72^{b}	140.51 ± 15.07^{ab}	5.171	0.007
Hy-C3-S/°	91.13 ± 13.05	89.69 ± 10.40	94.43 ± 10.19	2.920	0.056
Male	97.38 ± 13.06	90.77 ± 9.44	95.34 ± 8.20	2.411	0.097
Female	87.66 ± 11.84	89.17 ± 10.90	93.51 ± 11.93	2.257	0.110
C3-Hy-S/°	94.95(91.39, 101.05)	95.27(85.08, 99.58)	93.15(86.90, 101.82)	1.579$^{\#}$	0.454
Male	100.73(95.11, 107.38)	95.07(72.33, 106.80)	101.42(74.41, 106.17)	1.526$^{\#}$	0.466
Female	93.06(89.49, 97.00)	95.27(88.80, 97.14)	91.74(87.87, 95.10)	3.616$^{\#}$	0.164

#: Kruskal-Wallis H test were used. a, b, c: the same letters indicate no statistically significant difference, and different letters indicate significant differences between groups. Hy-Ba: distance between most anterior and superior point on the body of hyoid bone (Hy) and Basion; Hy-RGn: distance between Hy and most protrusive point of retrognathion (RGn); Hy-C3: distance between Hy and most anterior and inferior point of third cervical vertebra (C3); Hy-FH: vertical distance from Hy to Frankfort horizontal plane; Hy-MP: vertical distance from Hy to mandibular plane; Hy-C3RGn: vertical distance from Hy to C3-RGn line; C3-RGn: distance between C3 and RGn; Go-Hy-Me: angle between Gonion-Hy line and Hy-Menton line; Hy-C3-S: angle between Hy-C3 line and C3-Sella line; C3-Hy-S: angle between C3-Hy line and Hy-Sella line

显的后下移位。

骨性Ⅲ类患者的C3-RGn与Hy-RGn距离均最大，反映出该类患者下颌骨的前突形态。整体分析中，观察到骨性Ⅲ类患者的C3-Hy-S角小于Ⅰ类患者；未成年人群中存在类似的发现；而成年群体中未观察到C3-Hy-S角在三组患者间的差异。由此可说明未成年骨性Ⅲ类患者的舌骨离颈椎及后颅底较远，有前移趋势，这可归因于下颌前突牵引舌骨前移。成年骨性Ⅲ类患者舌骨位置与Ⅰ类患者无差异，可能由于生长发育完成，舌骨又逐步调整至中位。与本研究类似，部分既往研究也未观察到成年骨性Ⅲ类和Ⅰ类患者舌骨位置的显著差异[10]。但也有研究表明，骨性Ⅲ类患者的舌骨相较于Ⅰ类前移[11]。与这些研究相比，本研究在研究人群、纳入排除标准等方面均有不同，可能还有其他混杂因素影响成年骨性Ⅲ类患者舌骨位置。仍需进一步研究确定成年骨性Ⅲ类与Ⅰ类患者舌骨位置的差异。

本研究采用了更丰富的头影测量指标使舌骨位置的测量更为精确，并进行了年龄分层分析，最

终观察到不同矢状向骨面型的患者舌骨位置的显著差异。正畸医师可根据患者骨性错𬌗类型判断其舌骨位置，并可进一步预估患者的气道通畅程度及颞下颌关节状态，以达全面精准评估口颌系统功能的目的。成年女性Ⅱ类患者的舌骨较靠后下，气道可能较为狭小，在正畸治疗过程中可能存在通气不足等不适感。骨性Ⅱ类患者已被视为阻塞性睡眠呼吸暂停低通气综合征的高危人群[12]。因此，在临床诊疗中口腔医师应更加关注成年女性Ⅱ类患者，告知病人病情并评估其通气功能，必要时给予呼吸功能调整等干预措施，以防严重并发症的发生。尽管未成年骨性Ⅲ类患者的舌骨位置前移，但成年骨性Ⅲ类患者的舌骨位置与Ⅰ类患者类似，气道可能并无显著增大，Ⅲ类患者呼吸状况仍需重视。

本研究仍存在一定不足。首先，本研究为横断面研究，矢状向骨面型与舌骨位置的因果关系仍未阐明。下颌骨形态位置变化可牵引舌骨移动，舌体舌骨位置变化也可影响牙槽骨结构，可能在骨性错𬌗的发生发展中具一定作用[9,13]，仍需深入纵向研究骨性错𬌗与舌骨位置的关系。其次，尽管本研究中三组患者的垂直面型分布无差异，但垂直面型可能仍存在一定混杂效应，还需更多研究探寻矢状与垂直面型对舌骨位置的共同作用。

总之，骨性Ⅰ类、Ⅱ类和Ⅲ类错𬌗患者的Hy-RGn、C3-RGn距离、Go-Hy-Me、C3-Hy-S角等舌骨位置测量指标存在差异，在成年女性群体及未成年群体中差异更为明显。与骨性Ⅰ类患者相比，成年女性Ⅱ类患者的舌骨更远离下颌，有后下移动趋势；未成年骨性Ⅲ类患者的舌骨更远离颈椎与后颅底，有前移倾向。

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参考文献

[1] Hasanzadeh MH, Labafchi A, Mortazavi S, et al. The effect of orthognathic surgery on the hyoid bone position in skeletal class Ⅲ patients: an evaluation using cephalometric analysis[J]. World J Plast Surg, 2021, 10(2): 46-54. doi: 10.29252/wjps.10.2.46.

[2] Nejaim Y, Aps J, Groppo FC, et al. Evaluation of pharyngeal space and its correlation with mandible and hyoid bone in patients with different skeletal classes and facial types[J]. Am J Orthod Dentofacial Orthop, 2018, 153(6): 825-833. doi: 10.1016/j.ajodo.2017.09.018.

[3] Ekici Ö, Camcı H. Relationship of temporomandibular joint disorders with cervical posture and hyoid bone position[J]. Cranio. 2021, 18: 1-10. doi: 10.1080/08869634.2021.1926745.

[4] Zhou X, Xiong X, Yan Z, et al. Hyoid bone position in patients with and without temporomandibular joint osteoarthrosis: a cone-beam computed tomography and cephalometric analysis[J]. Pain Res Manag, 2021: 4852683. doi: 10.1155/2021/4852683.

[5] Mortazavi S, Asghari-Moghaddam H, Dehghani M, et al. Hyoid bone position in different facial skeletal patterns[J]. J Clin Exp Dent, 2018, 10(4): e346-e351. doi: 10.4317/jced.54657.

[6] Wu S, Wang T, Kang X, et al. Hyoid bone position in subjects with different facial growth patterns of different dental ages[J]. Cranio, 2021: 1-7. doi: 10.1080/08869634.2020.1867471.

[7] 陈扬熙. 口腔正畸学--基础,技术与临床[M]. 北京: 人民卫生出版社, 2012.
Chen YX. Orthodontics - foundation, technology and clinical [M]. Beijing: People's Medical Publishing House, 2012.

[8] Xiong X, Zhang Q, Liu Y. Correlations between mandibular ramus height and occlusal planes in Han Chinese individuals with normal occlusion: a cross-sectional study[J]. APOS Trends in Orthodontics, 2022, 11(4): 295-300. doi: 10.25259/apos_78_2021.

[9] Chen W, Mou H, Qian Y, et al. Evaluation of the position and morphology of tongue and hyoid bone in skeletal Class II malocclusion based on cone beam computed tomography[J]. BMC Oral Health, 2021, 21(1): 475. doi: 10.1186/s12903-021-01839-y.

[10] 梅冬兰, 韩立赤, 阎振梅, 等. 应用锥形束CT比较骨性Ⅲ类高角𬌗与正常𬌗成人上气道形态和舌骨位置的意义[J]. 吉林大学学报 (医学版), 2019, 45(4): 899-904. doi: 10.13481/j.1671-587x. 20190427.
Mei DL, Han LC, Yan ZM, et al. Significance of comparison in upper airway morphology and hyoid position between skeletal class Ⅲ malocclusion of high-angle and normal occlusion of adults by cone beam CT [J]. J Jilin University (Medicine Edition), 2019, 45 (4): 899-904. doi: 10.13481/j.1671-587x.20190427.

[11] Bilal R. Position of the hyoid bone in anteroposterior skeletal patterns[J]. J Healthc Eng, 2021: 7130457. doi: 10.1155/2021/7130457.

[12] Raffaini M, Pisani C. Clinical and cone-beam computed tomography evaluation of the three-dimensional increase in pharyngeal airway space following maxillo-mandibular rotation-advancement for Class Ⅱ-correction in patients without sleep apnoea (OSA) [J]. J Craniomaxillofac Surg, 2013 , 41(7): 552-557. doi: 10.1016/j.jcms.2012.11.022.

[13] Fatima F, Fida M. The assessment of resting tongue posture in different sagittal skeletal patterns[J]. Dental Press J Orthod, 2019, 24 (3): 55-63. doi: 10.1590/2177-6709.24.3.055-063.oar.

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