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·防治实践·

骨性上颌前突伴双重咬合正畸治疗1例及文献回顾

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【摘要】　目的　评估以正中关系（centric relation，CR）为导向联合微种植体强支抗与长牵引钩控根内收上前牙，治疗骨性上颌前突伴双重咬合患者的临床效果及稳定性，为临床提供参考。**方法**　报道1例29岁成年女性骨性上颌前突、CR位与最大牙尖交错位（maximum intercuspation position，MIP）不调的无症状双重咬合病例。首先通过临床手法和CBCT检查识别和获取CR位，采用玻璃离子咬合印记和肌功能训练辅助稳定CR位，然后通过上颌微种植体联合长牵引钩内收上前牙改善骨性上颌前突，最终在CR位上建立新的牙尖交错咬合关系并维持长期稳定。结合文献回顾以阐释治疗逻辑与关键环节。**结果**　患者治疗后在CR位建立了协调、稳定的功能性咬合，患者颞下颌关节无不适，髁突与关节窝关系协调，上前牙实现了控根内收，侧貌凸度显著改善。治疗后3年随访，CR位咬合关系与髁突位置保持稳定。文献复习提示：对CR-MIP不调患者，优先识别与稳定CR位是治疗成败的关键；微种植体可有效实现上前牙内收并改善侧貌。**结论**　对于骨性上颌前突伴双重咬合患者，采取“先行确立CR位+微种植体强支抗控根内收”的策略，可同步改善牙颌系统功能与面型，且具有良好的中长期稳定性。

【关键词】　骨性上颌前突；　双重咬合；　正中关系；　最大牙尖交错位；　颞下颌关节；　髁突移位；　微种植体支抗；　牵引钩；　控根内收；　上颌前牙
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Orthodontic treatment of skeletal maxillary protrusion with dual bite: a case report and literature review

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【Abstract】　Objective　To evaluate the clinical efficacy and stability of a centric relation (CR)-guided approach combined with micro-implant anchorage and long traction hooks for root-controlled retraction of the maxillary anterior teeth in a patient with skeletal maxillary protrusion and dual bite, and to provide a reference for clinical practice. **Methods**　A case of a 29-year-old female patient with skeletal maxillary protrusion and an asymptomatic discrepancy between the maximum intercuspation position (MIP) and CR (dual bite) was reported. First, the CR was identified and obtained by cone beam computed tomography examination and clinical techniques, then was stabilized by glass ionomer bite registration and myofunctional training. Maintaining the CR, the maxillary micro-implants combined with long traction hooks were used to correct skeletal maxillary protrusion by facilitating maxillary anterior teeth retraction, and finally a new intercuspal occlusion was established to maintain long-term stability. A literature review was conducted to contextualize the treatment rationale and key steps. **Results**　Post-treatment, a coordinated and stable functional occlusion was established in CR without temporomandibular joint symptoms, and the condylar location was coordinated with

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the glenoid fossa. Controlled root retraction of the maxillary anterior segment and facial profile improvement were achieved. At 3-year follow-up, both occlusion in the CR and condylar positions remained stable. The literature review indicated that, in patients with CR-MIP discrepancy, prioritizing the identification and stabilization of CR is critical, and micro-implant anchorage with long traction hooks effectively facilitates maxillary anterior teeth retraction and profile improvement. **Conclusion**　For skeletal maxillary protrusion with dual bite, a CR-first strategy combined with micro-implant anchorage and long-hook mechanics for root-controlled anterior retraction can concurrently improve stomatognathic function and facial aesthetics, demonstrating favorable mid- to long-term stability.

【Key words】 skeletal maxillary protrusion; dual bite; centric relation; maximum intercuspation position; temporomandibular joint; condylar displacement; micro-implant anchorage; traction hooks; root-controlled retraction; maxillary anterior teeth

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骨性上颌前突是临床常见的错𬌗畸形之一[1]，临床上部分患者为代偿颌间矢状向关系不调，可出现下颌功能性前伸，形成双重咬合，即同时存在正中关系（centric relation，CR）位与最大牙尖交错位（maximum intercuspation position，MIP）两个可重复的颌位[2]。这种CR-MIP不调显著增加了诊断与治疗的复杂性[3]，若处理不当则可能导致咬合不稳定、颞下颌关节紊乱症等并发症[4]。尽管已有文献报道了双重咬合正畸治疗病例，但是报道的患者多伴随颞下颌关节（temporomandibular joint，TMJ）症状及病变，CR位不能自主维持，而且缺乏长期稳定性评估[5-6]。本研究的创新性在于识别了未出现任何TMJ症状及病变、有2个可自主重复的稳定颌位的双重咬合患者，并以稳定CR位作为治疗设计的首要考量，系统阐述了微种植体支抗配合长牵引钩改善骨性上颌前突的生物力学策略，并通过治疗后的长期随访验证了治疗效果的稳定性，特别是CR位的维持及髁突位置的稳定。

1　病例资料

1.1　临床检查

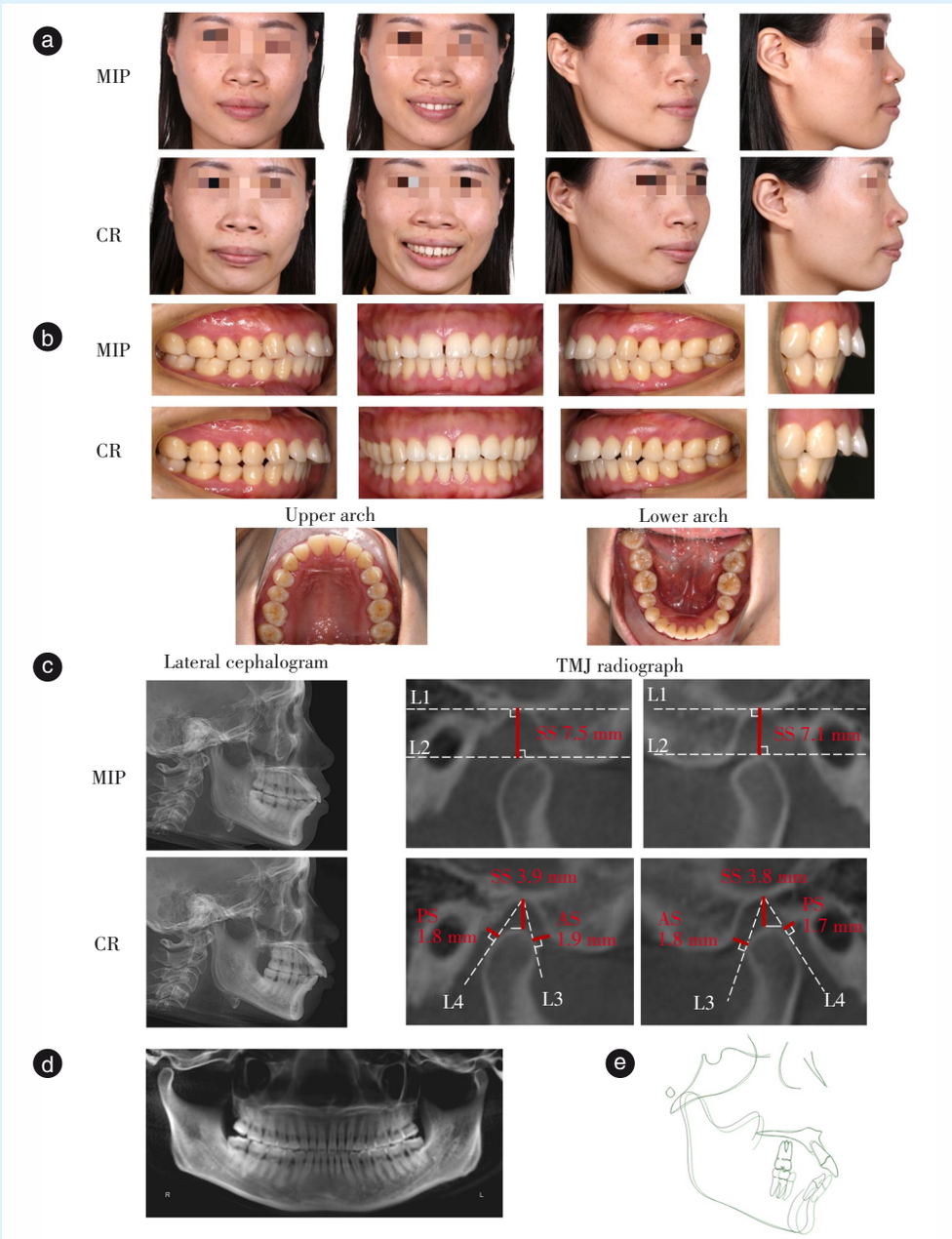
患者，女性，29岁，主诉发现侧貌前突多年。专科检查（图1）：面部轻度不对称，面下1/3高度正常，侧貌突，上下唇均位于E线前（图1a）。张口度正常，张口型↓，双侧TMJ无弹响，无压痛。MIP磨牙、尖牙中性关系，前牙Ⅰ度深覆盖，覆𬌗正常，上牙列约3 mm间隙，下牙列Ⅰ度拥挤，牙尖磨耗变平（图1b）。头颅侧位片示：骨性Ⅰ类，上下颌骨前突，上下前牙唇倾，低角（图1c）。关节片及全景片示：18/28/38/48萌出，髁突明显向前移位，离开关节窝中央区域，髁突形态良好，骨皮质连续（图1c、1d）。

CR位磨牙、尖牙关系变为远中尖对尖，前牙增大至Ⅲ度深覆盖，下颌明显后缩，侧貌突度较前增大（图1a、1b）。CR位关节片示：髁突退回关节窝中（图1c）。CR位头颅侧位片示：SNB角由MIP的88°减少至85.2°，ANB角由MIP的3.7°增大至6.5°，下颌平面角约增加1°：SN-MP由MIP的25°增加至26.1°，FMA由MIP的20.7°增加至21.9°，CR-MIP重叠图也证实CR位对比MIP，下颌骨后退，下颌平面角增大（图1e）。

1.2　颞下颌关节检查

采用Kamelchuk法[7]测量TMJ间隙：过关节窝顶点及髁突顶点作FH平面的水平线L1和L2，L1与L2之间的垂直距离为关节上间隙（superior space，SS）。过关节窝顶点作髁突前缘和后缘的切线L3和L4，从髁突前缘的切点做L3的垂线，该垂线到关节窝的距离即为关节前间隙（anterior space，AS），同理，从髁突后缘L4的切点到关节窝的垂直距离即为关节后间隙（posterior space，PS）（图1c）。治疗前MIP时，髁突向前向下移出关节窝，导致AS、PS无法测量，右侧SS为7.5 mm，左侧SS为7.1 mm（图1c）。治疗前CR位时，髁突回归到关节窝中，右侧AS为1.9 mm，SS为3.9 mm，PS为1.8 mm；左侧AS为1.8 mm，SS为3.8 mm，PS为1.7 mm（图1c）。

采取Roth肌动力正中关系获取法引导患者至CR位：右手拇指于颏前点施加向下方向的力，食



a: facial photographs of a 29-years-old female patient, the maximum intercuspation position (MIP) shows maxillary and mandibular protrusion, the centric relation (CR) shows mandibular posterior movement comparing to MIP; b: intraoral images in the MIP show Class Ⅰ relationship, images of the CR show Class Ⅱ relationship and deeper overjet, and in images of upper and lower arch with dental attrition, upper arch shows spaces and lower arch shows mild crowding; c: lateral cephalogram in the MIP shows skeletal Class Ⅰ relationship; lateral cephalogram in the CR shows skeletal Class Ⅱ relationship; temporomandibular joint (TMJ) radiographs in the MIP show that lines L1 and L2 are parallel to the Frankfort Horizontal (FH) plane and tangent to the superior points of the glenoid fossas and condyles, where the superior space (SS) is the perpendicular distance between L1 and L2. The right TMJ superior space (SS) is 7.5 mm and the left TMJ SS is 7.1 mm; TMJ radiographs in the CR show that Lines L3 and L4 start from the superior points of the glenoid fossas and respectively tangent to the anterior and posterior points of the condyles, where the anterior space (AS) and the posterior space (PS) is the perpendicular distance from the tangent anterior and posterior points of the condyles to the glenoid fossas. The right TMJ AS is 1.9 mm, SS is 3.9 mm, and PS is 1.8 mm; the left TMJ AS is 1.8 mm, SS is 3.8 mm, and PS is 1.7 mm; d: panoramic radiograph shows the existence of 18, 28, 38, 48; e: superimposed cephalometric tracings of pretreatment MIP (green lines) and CR (black lines); pretreatment mandible moves backward in the CR comparing to in the MIP

Figure 1　Pretreatment photographs and imaging examinations of a 29-year-old female patient with skeletal maxillary protrusion and dual bite

图1　29岁女性骨性上颌前突伴双重咬合患者正畸治疗前照片和影像学检查

指于颏下点施加向上方向的力。嘱患者放松，在医生诱导下进行开闭口运动。患者能自主重复并维持该颌位，未诉TMJ不适。患者自述在日常生活中并未意识到存在双重咬合，习惯性咬合位为MIP。

1.3　诊断

CR-MIP不调，双重咬合，骨性Ⅱ类错𬌗，安氏Ⅱ类错𬌗，上颌骨前突，低角。

1.4　治疗计划

拔除14、24、35、45及18、28、38、48，采用0.022英寸槽沟直丝弓矫治系统，排齐整平上下牙列，治疗中维持CR位，上颌植入微种植体并使用长牵引钩进行前牙段整体内收，下颌采用中度支抗前移磨牙，内收下前牙，调整咬合关系，改善侧貌。

1.5　治疗过程

该患者正畸治疗中照片和影像学检查如图2所示。治疗中采取Roth肌动力正中关系获取法获取CR位，并教导患者自主重复维持。玻璃离子垫高过程中的关键注意事项包括（图2a）：①垫高位置的选择：在CR位下，选择上颌第一磨牙和第二磨牙的中央窝区域，避免在斜面或尖顶上垫高，以防产生侧向滑动力；②垫高高度的控制：初次垫高高度以分离前牙1~2 mm为宜，不宜过高，过高可能导致咬合不稳定或引发新的TMJ症状；③垫高点的分布：上颌双侧对称垫高，确保颌位的稳定性和左右平衡，使用咬合纸检查，确保CR位下每侧垫高至少2~3个均匀接触点；④避免产生新干扰点：垫高后应仔细检查下颌侧方和前伸运动，确保无新的咬合干扰产生，特别要注意工作侧和非工作侧的接触关系；⑤患者配合度评估：垫高后观察患者能否适应，是否出现咬合不适、肌肉疲劳或TMJ症状，若出现不适应及时调整；⑥定期复查调整：每4~6周复诊时重新评估CR位和垫高效果，检查玻璃离子是否磨耗、松脱，必要时重新垫高。患者CR位肌功能训练包括：每日3次、每次5~10 min的主动下颌后退训练，配合镜前视觉反馈和咬合印记提示，形成神经肌肉记忆。

排齐整平阶段6个月后，在上颌第二前磨牙、第一磨牙间颊侧植入微种植体支抗钉（直径1.5 mm，长度10 mm），上颌使用0.019×0.025 ss主弓丝加9 mm长牵引钩，以强支抗控根内收上前牙，牵引力150~200 g/侧（图2a、2b）。上牙列采用两步法内收上前牙，即先将上颌尖牙远移至尖牙中性关系，然后整体内收上前牙。下颌采取中度支抗分步前移下颌磨牙，即先将下颌第一磨牙近中移动至磨牙中性关系，再前移下颌第二磨牙（图2b）。治疗中尽快将尖牙、磨牙关系调整至中性关系，有利于稳定CR位，然后逐渐磨除上颌玻璃离子垫高。整个治疗过程未使用Ⅱ类牵引，以避免破坏已稳定的CR位，矫正疗程40个月。

头颅侧位片及重叠图示：下颌颌位与治疗前CR位重叠，与治疗前MIP不重叠（图2c、2d），TMJ检查示：髁突与关节窝关系协调（图2e），提示患者颌位稳定维持在CR位。整个治疗过程患者配合度良好，未出现支抗钉松动或软组织炎症。

1.6　治疗结果

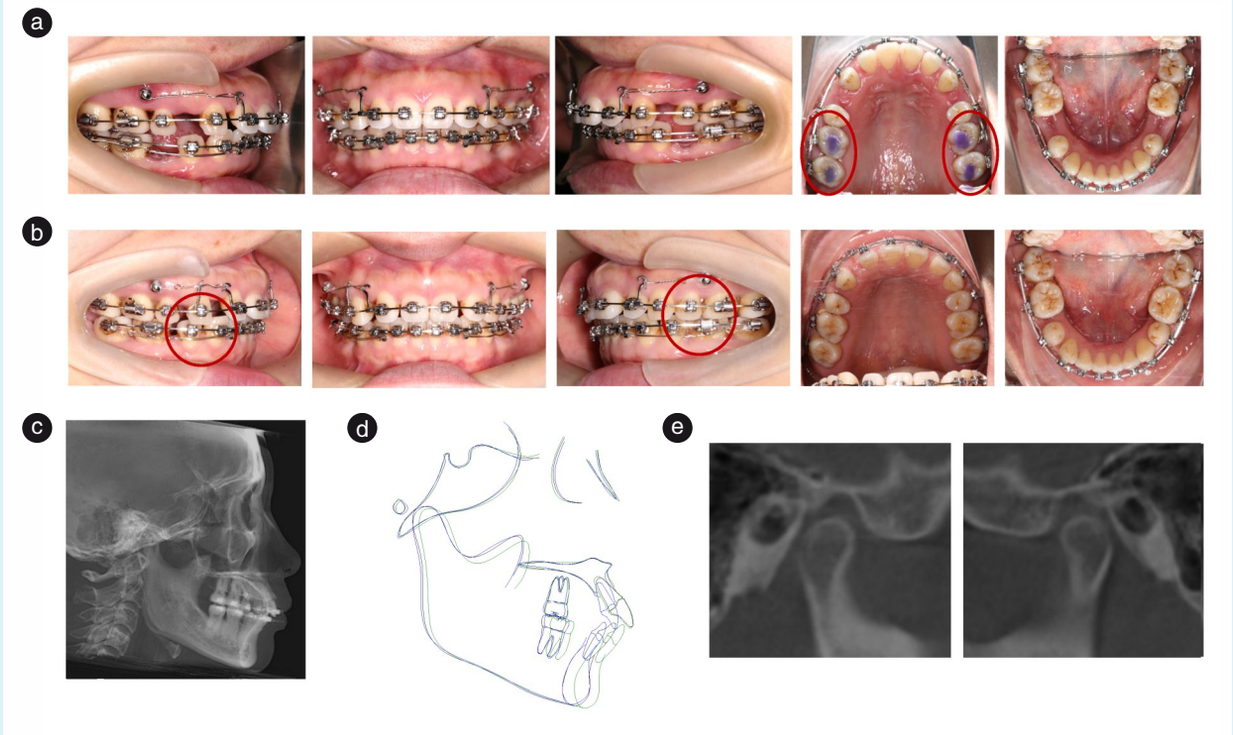
正畸治疗后及3年随访照片及影像学检查见图3。治疗后侧貌对比，上颌前突改善明显，口内检查：上下牙列排列整齐无间隙，咬合关系良好，保持3年效果稳定（图3a、3b）。TMJ检查：张口度正常、张口型↓，双侧颞下颌关节无弹响、无压痛。患者对治疗结果满意，面部美观和咬合功能均得到明显改善，3年保持期内未出现复发或TMJ不适症状。患者报告日常进食时咬合更加舒适，不再需要有意识地调整下颌位置来寻找舒适的咬合状态，咀嚼效率较治疗前提升。

头颅侧位片（图3c）及头影测量分析（表1）显示：上颌骨前突改善，矢状向骨面型改善（SNA由91.7°降至89.0°，ANB角由6.5°减小至5.5°）；上前牙内收效果显著（U1-SN由121.5°降低至102.7°，U1-NA由9.5 mm减小至−0.5 mm），下前牙基本直立于牙槽基骨中（L1-MP由106.5°减少至91.2°）；垂直向保持稳定（SN-MP由26.1°变化至25.6°，FMA由21.9°变化至21.6°）。3年随访治疗结果基本稳定。

牙根及牙周评估（全景片）：牙根平行度良好，牙根无明显吸收，所有牙齿牙根长度正常，未见明显病理性变化，牙周状况良好（图3c）。

关节及颌位评估：头影重叠图示：治疗前CR位、治疗后及3年随访的下颌位置基本重叠，CR位基本维持稳定（图3d）。

关节片对比及关节间隙测量结果显示：治疗后及3年随访，髁突与关节窝位置协调且稳定，未出现髁突病理性改变（图4），治疗后及3年随访右侧关节前间隙AS基本维持在1.9 mm，上间隙SS维持在3.9 mm，后间隙PS维持在1.9 mm，左侧AS 1.8 mm，SS 3.9 mm，PS 1.8 mm，与治疗前CR位测量结果接近一致（表2），表明髁突位置稳定维持在CR位。



a: intraoral photographs (treatment at month 6) show glass ionomer on the occlusal surfaces of the maxillary molars (shown as red circles); b: intraoral photographs (treatment at month 24) show a Class I canine and molar relationship (shown as red circles); c: lateral cephalogram shows a skeletal and occlusal Class I relationship; d: superimposed cephalometric tracings of the pretreatment maximum intercuspation position (MIP) (green lines), pretreatment centric relation (CR) (black lines), and mid-treatment position (blue lines), showing that the mandibular position during the treatment remains in the pretreatment CR, distinct from the pretreatment MIP; e: temporomandibular joint (TMJ) radiographs show that the condylar location is coordinated with the glenoid fossa

Figure 2　Photographs and imaging examinations of a 29-year-old female patient with skeletal maxillary protrusion and dual bite during the orthodontic treatment

图2　29岁女性骨性上颌前突伴双重咬合患者正畸治疗中照片和影像学检查

本次治疗成功实现了在稳定CR位上建立功能性咬合，并通过前牙控根内收改善骨性Ⅱ类错𬌗，侧貌显著改善，TMJ位置及功能协调稳定，长期稳定性良好。

2　讨　论

双重咬合是指患者同时存在MIP和CR位两个可重复的稳定颌位，且两者之间存在明显不调。MIP是上下颌牙列达到最大牙尖交错接触时的下颌位置，CR位是指髁突位于关节窝生理性居中位置时的下颌位置，均是可重复的生理性颌位[8]。其发病机制主要包括三个关键环节：①骨性不调是基础[9-10]，患者存在上颌前突或下颌后缩的矢状向骨性Ⅱ类关系，下颌代偿性前伸以获得较好的咬合关系；②咬合干扰[11-12]，包括后牙早接触和前牙深覆盖，触发下颌功能性移位；③神经肌肉适应[13]，长期功能性下颌前伸导致咀嚼肌群（特别是翼外肌）适应性改变，形成肌肉记忆。本病例虽存在明显的CR-MIP不调，但无TMJ症状，髁突形态正常，能自主重复并维持CR位，提示其属于神经肌肉功能适应性改变而非TMJ病理性改变。

本病例患者在MIP时呈现骨性Ⅰ类错𬌗+双颌前突的骨性特征，但在CR位时则转变为骨性Ⅱ类错𬌗+单纯的上颌前突，这一颌位变化显著改变了治疗诊断和治疗方案，严重下颌后缩患者甚至可能由非手术方案改变为正颌手术方案。这类双重咬合患者若在治疗前未能准确识别CR-MIP不调，在矫治过程中可能因无法通过牙性代偿协调矢状向关系不调而陷入困境，甚至不得不中途转为正颌手术。另外，临床上CR-MIP不调患者多伴随TMJ症状，本病例报道的无症状性双重咬合更为隐蔽，临床医师应提高警惕。研究表明，女性、成年

a: immediately posttreatment and 3 years posttreatment, facial photographs show that skeletal maxillary protrusion is improved and the treatment kept stable; b: immediately posttreatment and 3 years posttreatment, intraoral photographs show a Class I canine and molar relationship with normal overbite and overjet, and the occlusal relationship is well retained; c: immediately posttreatment, lateral cephalogram shows the skeletal Class I relationship; immediately posttreatment, a panoramic radiograph shows the Class I occlusal relationship; 3 years posttreatment, a lateral cephalogram and panoramic radiograph show the stability of the treatment; d: superimposed cephalometric tracings of the centric relation (CR) pretreatment (black lines), immediately posttreatment (red lines), and 3 years posttreatment (yellow lines), which show that the mandibular position tracings in the CR pretreatment, immediately posttreatment and 3 years posttreatment are superimposed well

Figure 3　Photographs and imaging examinations of a 29-year-old female patient with skeletal maxillary protrusion and dual bite immediately posttreatment and 3 years posttreatment

图3　29岁女性骨性上颌前突伴双重咬合患者正畸治疗后及3年随访照片及影像学检查

人、髁突形态异常、髁突后位、关节盘前移位等因素是TMJ出现症状的危险因素[14]。另外，本病例上牙列存在3 mm间隙、下牙列Ⅰ度拥挤、Spee曲度浅、上下牙弓形态及宽度协调，使得在下颌前伸

表1　29岁女性骨性上颌前突伴双重咬合患者治疗前后X线头影测量值

Table 1　X-ray cephalometric measurements of a 29-year-old female patient with skeletal maxillary protrusion and dual bite before and after orthodontic treatment　$\bar{x}\pm s$

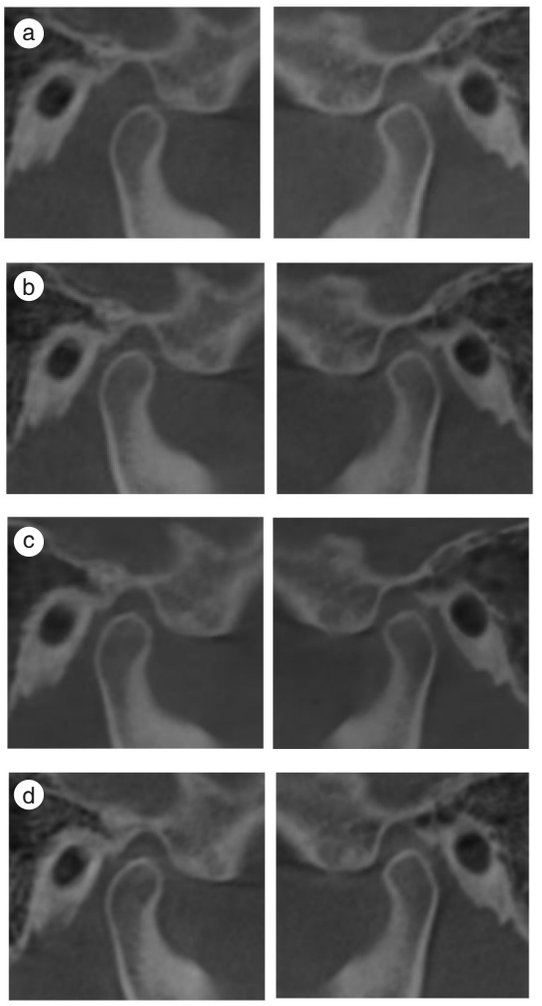
Measurement index	Pretreatment MIP	Pretreatment CR	Immediately posttreatment	3 years posttreatment	Normal value
SNA / °	91.7	91.7	89.0	90.1	83.0±3.9
SNB / °	88.0	85.2	84.4	84.8	80.4±3.6
ANB / °	3.7	6.5	5.5	5.3	2.6±1.8
FH-NP / °	91.5	89.3	90.3	88.8	85.8±3.1
NA-AP / °	9.7	13.7	11.0	11.0	5.2±2.1
U1-NA / mm	9.5	9.5	−0.5	1.1	5.8±2.1
U1-NA / °	28.8	29.8	12.8	16.2	23.6±4.6
L1-NB / mm	11.5	11.5	4.9	5.0	7.2±2.0
L1-NB / °	37.0	37.8	24.2	22.1	30.8±4.9
U1-L1 / °	110.4	105.8	137.5	136.5	119.3±7.0
U1-SN / °	120.5	121.5	102.7	106.3	105.7±6.3
L1-MP / °	104.1	106.5	91.2	91.5	97.1±5.1
SN-MP / °	25.0	26.1	25.6	25.8	32.7±4.5
FMA / °	20.7	21.9	21.6	21.8	28.1±5.5
Yaix (SGn-SN) / °	64.6	66.1	66.4	66.1	63.4±3.8
Pg-NB / mm	−1.8	−0.1	0.3	0	0.3±1.3

MIP: maximum intercuspation position; CR: centric relation; S: sella; N: nasion; A: subspinale; B: supramental; Pg/P: pogonion; Gn: gnathion; FH: Frankfort horizontal plane; SN: the plane of S-N; NA: the plane of N-A; NB: the plane of N-B; NP: the plane of N-P; AP: the plane of A-P; U1: upper incisor; L1: lower incisor; MP: mandibular plane; SGn: the plane of S-Gn; SNA: sella-nasion-subspinale angle; SNB: sella-nasion-supramental angle; ANB: difference between SNA and SNB; FH-NP: the angle between the FH and NP; NA-AP: the angle between the NA and AP; U1-NA (mm): the distance from the edge of the U1 to NA; U1-NA: the angle between the long axis of the U1 and NA; L1-NB (mm): the distance from the edge of the L1 to NB; L1-NB: the angle between the long axis of the L1 and NB; U1-L1: the angle between the long axis of the U1 and L1; U1-SN: the angle between the long axis of the U1 and SN; L1-MP: the angle between the MP and the long axis of L1; SN-MP: the angle between the MP and SN; FMA: the angle between the MP and FH; Yaix (SGn-SN): the angle between the SGn and SN; Pg-NB (mm): the distance from the Pg to NB

位时更容易找到良好的牙尖交错关系。值得注意的是,本病例患者的牙尖存在明显磨耗,这可能是长期双重咬合导致的适应性改变,同时牙尖磨耗降低了咬合干扰的程度,使得两个颌位都能够相对稳定地存在。治疗前准确的颌位诊断是正确制订治疗方案的前提,这提醒临床医师在面对成年女性骨性Ⅱ类患者时,应常规进行CR-MIP关系检查,特别是上下牙弓匹配度良好且Spee曲线较浅、牙尖明显磨耗的患者,即使无TMJ症状,也需警惕潜在的双重咬合风险。

随着CBCT在口腔正畸的普及应用,髁突位置和形态学评估也更为精准[15]。正常咬合患者髁突位于关节窝生理性居中区域,而安氏Ⅱ类1分类患者髁突往往更靠前[16-17],与本患者相符。髁突移位往往与骨性Ⅱ类错𬌗[18-21]、下颌平面角[19-21]、髁突高度与关节角[20]、关节退变[10, 22]、反𬌗[12]等相关。而关于CR位髁突理想位置则一直争议不断,从髁突最后位、后上位、最后最上最中位到髁突前上位,再到髁突前下位、以及治疗性颌位等等,其中前上位被大多数医生所认可[23]。另外,研究发现正畸治疗后髁突形态和位置会发生适应性改建[24-25]。本病例患者为功能良好的、无症状的适应性CR位,而非以髁突位置为导向的机械性CR位,治疗性CR位不应过分强调髁突位置,更多应强调口颌系统的功能和稳定[8, 23]。

对于骨性上颌前突的非手术治疗,强支抗控制是内收上前牙、改善侧貌的关键[26]。上颌支抗钉提供了绝对骨性支抗,无需依赖患者依从性,有效避免了磨牙支抗消耗[27-28],确保拔牙间隙全用于前牙内收。三维有限元分析表明,9 mm牵引钩是上前牙内收过程中牵引钩长度的最佳选择[29],无需在前牙上额外施加唇向转矩即可实现理想的控根内收,而3 mm和6 mm牵引钩分别需要额外10°和5°的唇向转矩补偿[29]。本病例采用9 mm长牵引钩,牵引力作用线更接近上前牙段阻抗中心,内收过程中前牙冠舌向倾斜的趋势减小,实现更好



a: pretreatment maximum intercuspation position (MIP) condyles move forward and downward, leaving the physiologic centric area of the glenoid fossas ; b: pretreatment centric relation (CR) condyles are coordinated with the glenoid fossas; c: condylar location remains after the treatment; d: condylar location remains 3 years posttreatment. TMJ: temporomandibular joint

Figure 4　TMJ radiographs of a 29-year-old female patient with skeletal maxillary protrusion and dual bite before and after orthodontic treatment

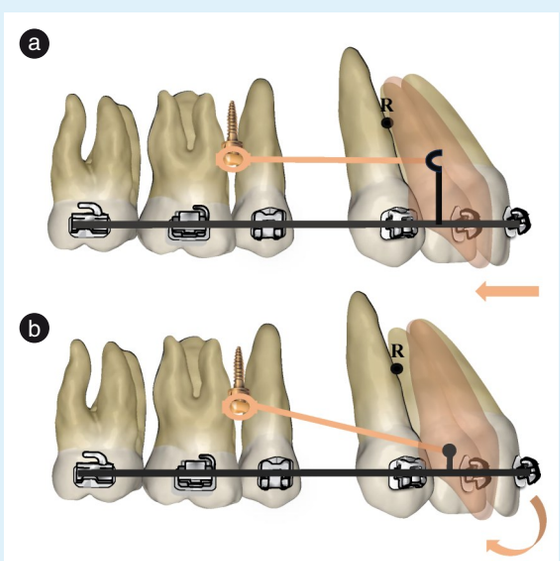
图4　29岁女性骨性上颌前突伴双重咬合患者正畸治疗前后颞下颌关节片对比

表2　29岁女性骨性上颌前突伴双重咬合患者治疗前后关节间隙测量值

Table 2　The joint space measurements of a 29-year-old female patient with skeletal maxillary protrusion and dual bite before and after orthodontic treatment

Measurement index		Pretreatment MIP	Pretreatment CR	Immediately posttreatment	3 years posttreatment
Right	AS / mm	—	1.9	1.9	1.9
	SS / mm	7.5	3.9	3.9	3.9
	PS / mm	—	1.8	1.9	1.9
Left	AS / mm	—	1.8	1.8	1.8
	SS / mm	7.1	3.8	3.9	3.9
	PS / mm	—	1.7	1.8	1.8

MIP: maximum intercuspation position; CR: centric relation; AS: anterior space; SS: superior space; PS: posterior space



a: root-controlled retraction of the maxillary anterior teeth by a long traction hook and micro-implant anchorage; b: crown tipping retraction of maxillary anterior teeth by a short traction hook and micro-implant anchorage. Point R: center of resistance of maxillary anterior teeth

Figure 5　Mechanical schematic diagram of different lengths of traction hooks for maxillary anterior retraction

图5　不同长度牵引钩的上前牙内收力学示意图

的上前牙转矩控制。另外,相对于短牵引钩会使矧平面顺时针旋转,9 mm牵引钩使滑动内收力线与主弓丝更接近平行,矧平面基本保持稳定,可实现更好的滑动力学机制[30](图5)。

长期稳定性是双重咬合患者治疗的难点。本病例3年随访保持稳定,主要归功于拔牙内收改善骨性不调,并在CR位建立平衡稳定的尖窝锁结咬合关系,且予足够治疗和保持时间使神经肌肉系统再适应。

该病例临床治疗要点包括:①治疗前通过临床检查和CBCT检查准确识别并记录CR位,确认患者能自主重复该颌位且无TMJ不适;②采用Roth肌动力法获取CR位,并通过机械引导(玻璃离子垫高)联合肌功能训练稳定CR位,每月定期

复查CR位稳定性；③以CR位下的颌骨关系为基础设计治疗方案，避免使用Ⅱ类牵引、功能矫治等可能诱导下颌前伸的力学手段；④优先调整尖牙、磨牙关系至中性，建立稳定咬合支撑。临床上对于CR-MIP不调的双重咬合患者，传统方法多采用𬌗架转移上颌模型并使用面弓记录确定咬合干扰点，然后通过佩戴稳定型𬌗板消除神经肌肉记忆，使下颌回到CR位[31]。然而，本病例中，患者能够自主重复CR位且无TMJ症状，无需长期佩戴𬌗板进行去程序化治疗。玻璃离子或复合树脂咬合垫高[32]应用于正畸治疗中的咬合打开，可提供稳定的后牙支撑点；而肌功能训练可有效消除咬合干扰对下颌位置的影响，帮助患者建立新的神经肌肉记忆[33]。本研究将两种方法联合应用，既通过玻璃离子垫高提供机械性的颌位引导，又通过肌功能训练强化神经肌肉适应，从而实现CR位的稳定维持。

此外，本研究作为单病例报告，其结论的外推性存在一定局限。如青少年与成年人的颌骨生长潜力不同，其颌位调整和稳定策略可能存在差异。不同骨面型（如高角型与低角型、安氏Ⅱ类和Ⅲ类）患者的肌肉功能和咬合力学特点不同，对微种植体加长牵引钩力学系统的反应可能不同。未来研究需纳入不同年龄、性别、骨面型的多样化病例，以验证本治疗策略的普适性。

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参考文献

[1] Pan J, Lu Y, Liu A, et al. Expert consensus on orthodontic treatment of protrusive facial deformities[J]. Int J Oral Sci, 2025, 17(1): 5. doi: 10.1038/s41368-024-00338-4.

[2] Radej I, Szarmach I. The role of maxillofacial structure on condylar displacement in maximum intercuspation and centric relation [J]. BioMed Res Int, 2022, 2022: 1439203. doi: 10.1155/2022/1439203.

[3] Parreiras Ferreira R, Isaias Seraidarian P, Santos Silveira G, et al. How a discrepancy between centric relation and maximum intercuspation alters cephalometric and condylar measurements[J]. Compend Contin Educ Dent. 2020, 41(4): e1-e6.

[4] Kattadiyil MT, Alzaid AA, Campbell SD. The relationship between centric occlusion and the maximal intercuspal position and their use as treatment positions for complete mouth rehabilitation: best evidence consensus statement[J]. J Prosthodont, 2021, 30(S1): 26-33. doi: 10.1111/jopr.13316.

[5] Alves CBC, Silva MAGS, Neto JV. The use of mini-plates for the treatment of a high-angle, dual bite, class II malocclusion[J]. Turk J Orthod, 2019, 32(1): 52-58. doi: 10.5152/TurkJOrthod.2018.18029.

[6] Lee GH, Park JH, Moon DN, et al. Protocols for orthodontic treatment of patients with temporomandibular joint disorders[J]. Am J Orthod Dentofacial Orthop, 2021, 159(3): 373-388. doi: 10.1016/j.ajodo.2020.09.023.

[7] Kamelchuk LS, Grace MG, Major PW. Post-imaging temporomandibular joint space analysis[J]. Cranio, 1996, 14(1): 23-29. doi: 10.1080/08869634.1996.11745945.

[8] Zonnenberg AJJ, Türp JC, Greene CS. Centric relation critically revisited-what are the clinical implications? [J]. J Oral Rehabil, 2021, 48(9): 1050-1055. doi: 10.1111/joor.13215.

[9] Zhou J, Yang H, Li Q, et al. Comparison of temporomandibular joints in relation to ages and vertical facial types in skeletal class II female patients: a multiple-cross-sectional study[J]. BMC Oral Health, 2024, 24(1): 467. doi: 10.1186/s12903-024-04219-4.

[10] Dygas S, Szarmach I, Radej I, et al. Influence of maxillofacial morphology on temporomandibular joint degenerative alterations and condyle position assessed by CBCT in class II malocclusion adult patients - a cross-sectional study[J]. J Clin Med, 2025, 14(13): 4499. doi: 10.3390/jcm14134499.

[11] Lekaviciute R, Kriauciunas A. Relationship between occlusal factors and temporomandibular disorders: a systematic literature review[J]. Cureus, 2024, 16(2): e54130. doi: 10.7759/cureus.54130.

[12] Kamar Alden HAR, Sultan K, Hajeer MY. The prevalence and possible association of different types of temporomandibular disorders among young adult patients with anterior and/or posterior crossbite: a cross-sectional study[J]. Cureus, 2024, 16(11): e74047. doi: 10.7759/cureus.74047.

[13] Easton JW, Carlson DS. Adaptation of the lateral pterygoid and superficial masseter muscles to mandibular protrusion in the rat[J]. Am J Orthod Dentofacial Orthop, 1990, 97(2): 149-158. doi: 10.1016/0889-5406(90)70088-t.

[14] Li C, Zhang Q. Comparison of imaging findings of 714 symptomatic and asymptomatic temporomandibular joints: a retrospective study[J]. BMC Oral Health, 2023, 23(1): 79. doi: 10.1186/s12903-023-02783-9.

[15] Almashraqi AA, Sayed BA, Mokli LK, et al. Recommendations for standard criteria for the positional and morphological evaluation of temporomandibular joint osseous structures using cone-beam CT: a systematic review[J]. Eur Radiol, 2024, 34(5): 3126-3140. doi: 10.1007/s00330-023-10248-4.

[16] Thekiya AH, Mahmood A, Naqvi ZA, et al. Three-dimensional assessment of the condylar position in different malocclusions using cone-beam computed tomography: a cross-sectional study[J]. Cureus, 2024, 16(12): e75704. doi: 10.7759/cureus.75704.

[17] Rivero-Millán P, Barrera-Mora JM, Espinar-Escalona E, et al. Comparison of condylar position in normal occlusion, class Ⅱ division 1, class Ⅱ division 2 and class Ⅲ malocclusions using CBCT imaging[J]. J Clin Exp Dent, 2021, 13(12): e1216-e1226. doi: 10.4317/jced.58970.

[18] Szyszka-Sommerfeld L, Sycińska-Dziarnowska M, Gerreth K, et al. The impact of malocclusion on the prevalence of pain-related temporomandibular disorders in children and adolescents: a systematic review[J]. Front Neurol, 2025, 16: 1550110. doi: 10.3389/fneur.2025.1550110.

[19] Radej I, Dargiewicz E, Sawczuk-Siemieniuk M, et al. The role of maxillofacial structure and malocclusion on condylar displacement in maximum intercuspation and centric relation in patients seeking orthodontic treatment-a scoping review[J]. J Clin Med, 2023, 12(2): 689. doi: 10.3390/jcm12020689.

[20] Osama A, Musa M, Zhang HJ, et al. Impact of craniofacial skeletal characteristics on temporomandibular joint's articular disc position in temporomandibular disorders[J]. Sci Rep, 2025, 15(1): 22090. doi: 10.1038/s41598-025-04938-w.

[21] Sui H, Xiao M, Jiang X, et al. Development and validation of a predictive nomogram for bilateral posterior condylar displacement using cone-beam computed tomography and machine-learning algorithms: a retrospective observational study[J]. BMC Oral Health, 2025, 25(1): 916. doi: 10.1186/s12903-025-06098-9.

[22] Görürgöz C, İçen M, Kurt MH, et al. Degenerative changes of the mandibular condyle in relation to the temporomandibular joint space, gender and age: a multicenter CBCT study[J]. Dent Med Probl, 2023, 60(1): 127-135. doi: 10.17219/dmp/147514.

[23] 张宏旗, 李晓箐, 孟玉坤. 口腔治疗中不同颌位与髁突位置[J]. 口腔疾病防治, 2020, 28(6): 399-403. doi: 10.12016/j.issn.2096-1456.2020.06.011.
Zhang HQ, LI XJ, Meng YK. Different jaw positions and condylar positions in oral therapy[J]. J Prev Treat Stomatol Dis, 2020, 28(6): 399-403. doi: 10.12016/j.issn.2096-1456.2020.06.011.

[24] Zheng J, Zhang Y, Wu Q, et al. Three-dimensional spatial analysis of the temporomandibular joint in adult patients with class II division 2 malocclusion before and after orthodontic treatment: a retrospective study[J]. BMC Oral Health, 2023, 23(1): 477. doi: 10.1186/s12903-023-03210-9.

[25] Lin Y, Lin Y, Fang F, et al. The effect of orthodontic treatment on temporomandibular joint morphology in adult skeletal class II deep overbite patients[J]. Am J Transl Res, 2021, 13(8): 9070-9075.

[26] Alhammadi MS, Qasem AAA, Yamani AMS, et al. Skeletal and dentoalveolar effects of class II malocclusion treatment using bimaxillary skeletal anchorage: a systematic review[J]. BMC Oral Health, 2022, 22(1): 339. doi: 10.1186/s12903-022-02363-3.

[27] Patel KS, Parmar I, Digumarthi UK, et al. Temporary anchorage device: a narrative review[J]. Cureus, 2025, 17(4): e81617. doi: 10.7759/cureus.81617.

[28] Umalkar SS, Jadhav VV, Paul P, et al. Modern anchorage systems in orthodontics[J]. Cureus, 2022, 14(11): e31476. doi: 10.7759/cureus.31476.

[29] Zalaquett R, Karam R, Kaddah F, et al. Effect of power arm length combined with additional anterior torque on the axial orientation of the maxillary incisors during en-masse retraction: a finite element analysis[J]. Am J Orthod Dentofacial Orthop, 2024, 165(2): 220-231. doi: 10.1016/j.ajodo.2023.08.016.

[30] 张丽雯, 郭润智, 王玥, 等. 使用种植体支抗三种加力方式关闭拔牙间隙前后的头影测量分析[J]. 中华口腔正畸学杂志, 2022, 29(4): 181-185. doi: 10.3760/cma.j.cn115797-20220518-22401.
Zhang LW, Guo RZ, Wang Y, et al. Cephalometric analysis of three different loading methods in en-masse retraction using mini-implant anchorage[J]. Chin J Orthod, 2022, 29(4): 181-185. doi: 10.3760/cma.j.cn115797-20220518-22401.

[31] Demirovic K, Dzemidzic V, Nakas E. Impact of stabilization splint therapy on orthodontic diagnosis in patients with signs and symptoms of temporomandibular disorder[J]. Biomedicines, 2024, 12(10): 2251. doi: 10.3390/biomedicines12102251.

[32] Elbarnashawy SG, Keesler MC, Alanazi SM, et al. Cephalometric evaluation of deep overbite correction using anterior bite turbos[J]. Angle Orthod, 2023, 93(5): 507-512. doi: 10.2319/061622-432.1.

[33] Stefani CM, de Lima AA, Stefani FM, et al. Impact of myofunctional therapy on orthodontic management and orthognathic surgery outcomes: a scoping review[J]. Eur J Orthod, 2025, 47(3): cjaf024. doi: 10.1093/ejo/cjaf024.

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