



Showcase Stop 16

Orthodontic-Orthognathic Combined Treatment

Case 1

Surgery-first approach for a patient with severe skeletal asymmetry



Writer Information

Dr. Yi Zhang

Associate Professor, Associate Chief
Physician, Master's Supervisor

Department of Orthodontics at the
Hospital of Stomatology Jilin University

01 General Information

A female patient, aged 25 years old, came for orthodontic treatment with the chief complaint of dental and facial asymmetry. She had aesthetic injection in her right chin, no other significant medical histories and also denied genetic history.

02 Clinical examination

Facial Examination

Pretreatment frontal face evaluation showed an asymmetrical face with the right side larger than the left and the chin shifted to the left, pronounced inclination of the occlusal plane. Bilateral pupils were also not on the same horizontal line.

Intraoral Examination

Sagittal: The left molars are in complete distal, and the right molars are mesial. There is a shallow overjet of the anterior teeth, and some teeth have reverse overjet.

Vertical: The overbite of the anterior teeth is normal. The Curve of Spee is flat.

Transverse: There is a significant difference (8.5 mm) in the midlines of the upper and lower dental arches. The left posterior teeth are in cross-bite.

Occlusal: Tooth 17 is absent; there is mild crowding in the lower dental arch (anterior tooth segment); the shape of the upper dental arch is asymmetrical.

Others: There is a large - area filling in tooth #47; tooth #36 has a crown restoration; tooth #22 has a resin veneer. There are fluorosed teeth, and the oral hygiene is good.

Temporomandibular Joint (TMJ) Examination

There is no obvious popping sound or murmur during opening and closing of the bilateral joints.



Pre-treatment Photos

03 Imaging Examination

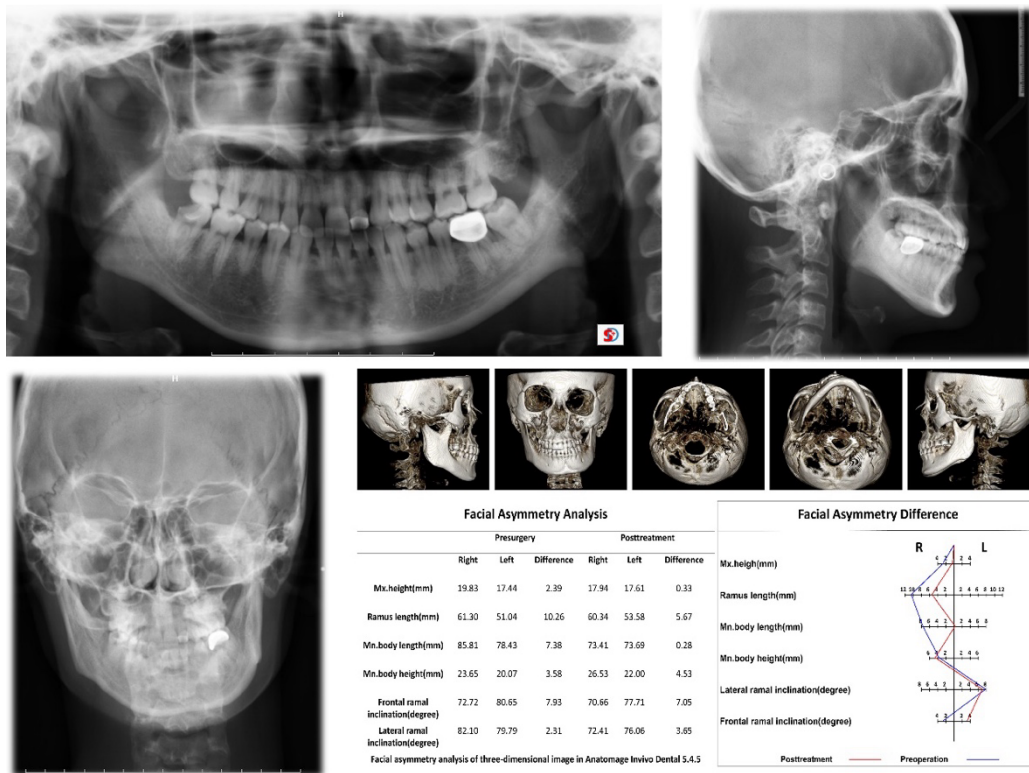
Panoramic Radiograph: #17、#18、#28、#38、#48(-); Tooth #22 has a resin crown, tooth #36 has a crown restoration, and tooth #47 has a large - area dental defect close to the pulp.

Posteroanterior Cephalogram: Skeletal asymmetry, the chin point deviates to the left. The right ramus of the mandible is longer than the left. The maxilla rotates counter - clockwise. The dental midline does not match the midline of the jawbone. The anterior teeth of the upper and lower jaws are inclined. The occlusal plane is deviated. The orbital heights are inconsistent.

Lateral Cephalogram: Class I skeletal malocclusion, the position of the chin is good, with a normal gonial angle. The position and angle of the upper anterior teeth are normal. The position of the lower anterior teeth is normal, and the lower anterior teeth are lingually inclined.

CBCT image analysis: The length of the right mandibular ramus is longer than that of the left. The inclination of the mandibular ramus is towards the left. The length of the right mandibular body is greater than that of the left.

Width Analysis: Three measurement methods show that the patient has mild stenosis of the maxillary dental arch.



Pretreatment imaging examination

04 Diagnosis

Skeletal Asymmetry

05 Treatment Analysis

Since the patient is eager to improve the facial appearance in a short period of time and refuses preoperative orthodontic treatment, the orthodontic and orthognathic team needs to fully negotiate whether the patient meets the indications for **surgery-first approach (SFA)** (Difficulty 1). If surgery-first approach is feasible, the next challenge is how to determine the position of the final occlusion (Difficulty 2).

Additionally, the patient received chin "aesthetic correction" 5 years ago, and the filling material in the chin cannot be removed or ablated. This has resulted in a significant discrepancy between the soft tissue pogonion and the hard tissue pogonion, which far exceeds the range of soft tissue compensation seen in ordinary skeletal mandibular deviation. This further increases the difficulty of soft tissue symmetry assessment and prediction of jaw movement (Difficulty 3).

Finally, the patient presents with orbital asymmetry combined with chin deviation, which greatly reduces the objectivity of facial symmetry judgment (Difficulty 4).

06 Design of Surgery-first approach and evaluation of final occlusion

Facial midline, Basal bone midline, Dental midline

Facial midline: It is an imaginary vertical line passing through key facial structures, starting from the glabella, passing through the nasal root, nasal tip, philtrum of the upper lip, the center of the lower lip in sequence, and finally extending to the center of the chin. It is used to evaluate facial symmetry, tooth arrangement, occlusal relationship and aesthetic design. For this patient, asymmetry existed starting from the upper 1/3 of the face, with inconsistent height of the bilateral orbits. After full consultation with the patient, the personalized facial midline was defined as the connecting line between the midpoint of the interpupillary line and the soft tissue nasal tip (solution to Difficulty 4).

Maxillary basal bone midline: A sagittal line passing through the midpoint of the anterior nasal spine, extending backward to the midpalatal suture and passing through the midpoint of the posterior nasal spine. For this patient, the maxillary basal bone midline is located 3mm to the right of the facial midline, and the maxillary dental midline is 2mm to the left of the maxillary basal bone midline.

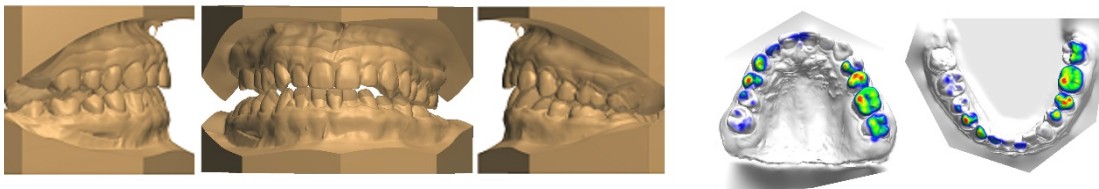
Mandibular basal bone midline: A sagittal line passing from the bony pogonion backward to the symphysis midline. Due to the patient's chin injection and large discrepancy between soft and hard tissue, the traditional mandibular basal bone midline cannot be used. After full consultation with the patient, the midpoint between the soft tissue pogonion and the hard tissue pogonion was adopted as the midpoint of the mandibular basal bone (solution to Difficulty 3). At this position, the mandibular basal bone midline is 7mm to the left of the facial midline, and the mandibular dental midline is 1mm to the left of the mandibular basal bone midline.

Movement of jaws and changes of occlusion (midline, overjet, molar relationships on both sides)

偏航角 Yaw			基骨-面中线差异 Jaws-Face	牙列与基骨中线 Dental-Jaws	牙列与面中线 Dental-Face
	初始 Initial	上颌Upper	3mm (R)	2mm (L)	1mm (L)
		下颌Lower	7mm (L)	1mm (R)	6mm (R)
	终末 Final	上颌Upper	0 (CW 4°)	2mm (L)	2mm (L)
		下颌Lower	0 (CCW 9°)	1mm (R)	1mm (R)

偏航角 Yaw			U6-L6	颌骨移动 Bone Movement		磨牙关系 Molar Relationship	前牙覆盖 Overjet
	初始 Initial	左侧 (Left)	-4mm	上颌骨 Maxillary	后退3mm	完全远中/ Class II	0.5mm
		右侧 (Right)	7mm		前移1mm	完全近中/ Class III	-1mm
	终末 Final	左侧 (Left)	1mm	下颌骨 Mandible	后退3mm	基本中性/ Class I	5mm
		右侧 (Right)	-3mm		后退9mm	完全远中/ Class II	

Final occlusion



Final occlusion and occlusal contacts

Sagittal direction: The left molars are neutral; the right molars are completely distal; II° deep overjet.

Horizontal direction: There is a 3mm discrepancy between upper and lower midlines; the overbite of the right posterior teeth is shallow.

Vertical direction: The overbite of the anterior teeth is normal. The right posterior teeth have light contact, and the left posterior teeth have extensive contact points.

Treatment Objective and treatment plan

Adjust midlines: Reserve miniscrew during orthognathic surgery to adjust the midlines and improve occlusion.

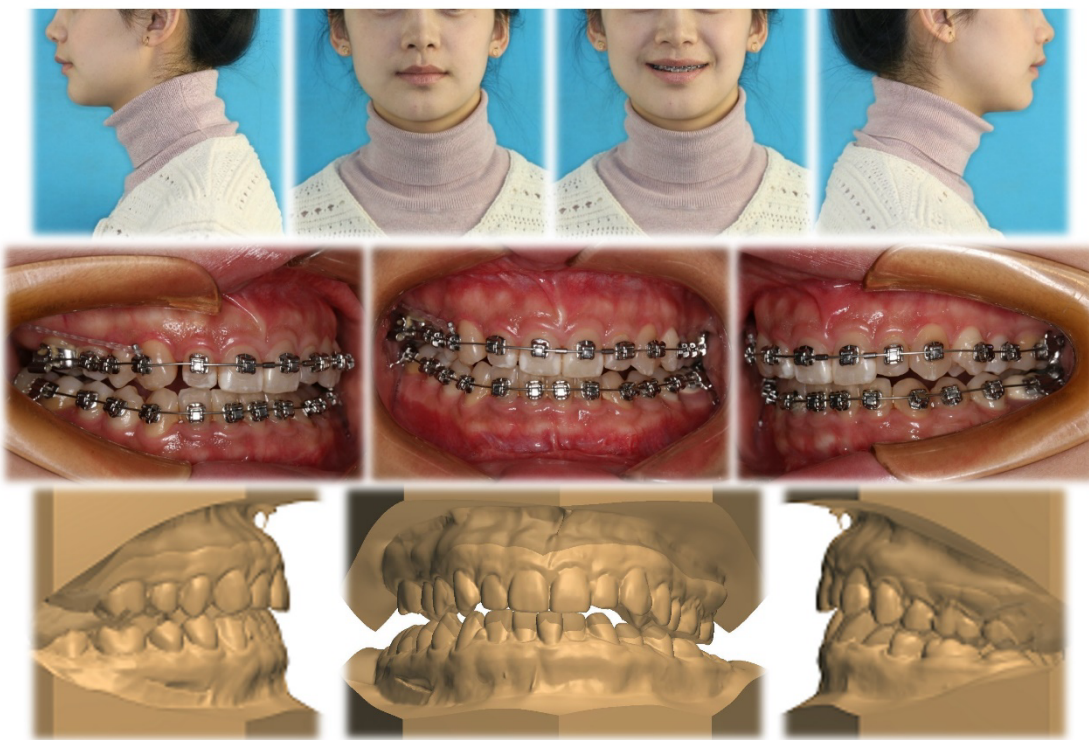
Correct II° deep overjet: Slightly move the lower anterior teeth labially during the process of aligning and leveling, maintain the position of the upper anterior teeth.

Establish a cusp - fossa interdigitation occlusal relationship.

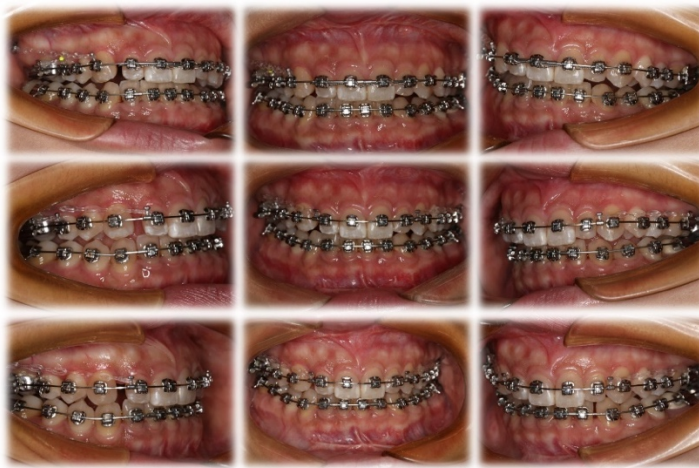
07 Treatment progress



Bond brackets 4 days before surgery



First appointment, 5 weeks after surgery



矫治过程关注点:

- ✓ 上颌中线
- ✓ 右侧磨牙关系
- ✓ 下前牙排齐整平
- ✓ 前牙覆盖的减小

Post-surgery orthodontic treatment progress

08 Treatment Results

After 13 months of post-surgery orthodontic treatment, the symmetry of the patient was significantly improved, the facial contouring was natural and smooth. The posttreatment photographs of the patient confirmed good esthetic and occlusal results. The cephalometric analysis showed significant improvement in the soft and hard tissues. The interdigitation in the right molar area was unsatisfactory because of the absence of 17. The panoramic radiograph confirmed the parallel root positioning. The facial asymmetry analysis by CBCT showed that both the source and magnitude of deviations were corrected. The CBCT image of the TMJ showed no significant change of the condylar after treatment. Because of dental fluorosis, the patient underwent ultra - thin veneer restoration in the upper and lower anterior tooth regions. After restoration, the shape and color of the teeth blended well with the adjacent teeth. After 18 months of retention, the facial appearance, tooth alignment, and occlusion remained stable. The implant screw in the right upper posterior tooth region was removed, and the patient entered the stage of implant restoration for tooth #17.



Posttreatment photos



Posttreatment X rays



Photos after veneer treatment



18 months retention

Cephalometric measurement results

	Pre-	Post-	Norm $\pm$ SD
<i>MAXILLO-MANDIBULAR RELATIONSHIPS</i>			
Frontal Convexity,L (mm)	16.9	13.9	11.9 $\pm$ 2.5
Frontal Convexity,R (mm)	11.1	12.0	11.9 $\pm$ 2.5
Maxillo-Mandi Midline(mm)	-14.3	1.7	0.0 $\pm$ 2.0
<i>SKELETAL/DENTAL</i>			
Occlusal Plane Tilt	-4.9	-0.4	0.0 $\pm$ 2.0
Molar to Jaw,L (mm)	10.3	11.0	13.1 $\pm$ 1.7
Molar to Jaw,R(mm)	8.0	11.2	13.1 $\pm$ 1.7
Denture to Jaw Midline(mm)	-7.8	0.2	0.0 $\pm$ 1.5
<i>DEEP SKELETAL STRUCTURE</i>			
Maxillary Width(mm)	62.3	62.4	64.1 $\pm$ 3.0
Mandibular Width(mm)	85.6	81.5	81.3 $\pm$ 3.0
Facial Width(mm)	129.0	128.8	124.7 $\pm$ 3.0

Pre- and post- posteroanterior cephalogram results

	Pre-	Post-	Norm±SD
Skeleton			
SNA(°)	86.6	86.9	82.0±3.5
SNB(°)	84.7	83.0	80.9±3.4
ANB(°)	1.9	3.0	1.6±1.5
Pog-NB (mm)	0.9	2.0	3.0±1.7
FMA(°)	23.0	35.7	22.9±4.5
MP-SN(°)	30.8	35.7	33.0±6.0
Dental			
U1-NA(mm)	2.8	2.7	4.3±2.7
U1-NA(°)	17.2	17.4	22.8±5.7
L1-NB(mm)	3.8	5.2	4.0±1.8
L1-NB(°)	21.7	35	25.3±6.0
U1-SN(°)	103.8	102.4	103.1±5.5
IMPA(°)	86.2	96.3	95.0±7.0

Pre- and post- lateral cephalogram results

09 Treatment Experience

Orthodontic and orthognathic combined treatment for skeletal asymmetry

For patients with skeletal asymmetry mainly characterized by transverse malalignment, we need to evaluate the deviation from three dimensions: teeth, hard tissues, and soft tissues. If the occlusal plane of the patient is not deviated and the skeletal inclination is not severe, contour trimming can be considered. For patients with a deviated occlusal plane, the jaw needs to be realigned through orthodontic and orthognathic combined treatment. However, the correction of the asymmetry is not only limited to the hard tissues. Due to long-term compensation, the soft tissues have already adapted to the asymmetric condition. When necessary, soft tissue filling can be carried out to perfect the facial line contour. However, absolute symmetry hardly exists in human individuals. Only maximum improvement can be achieved through the modification of the dentition, bones, and soft tissues. And absolute symmetry should not be the ultimate goal pursued by patients and doctors.

Traditional orthodontic and orthognathic combined treatment and surgery first approach

The traditional orthodontic and orthognathic treatment is divided into three stages: pre-operative orthodontics, orthognathic surgery, and post-operative orthodontics. In the pre-operative orthodontic treatment, the problems of tooth arrangement that affect the orthognathic surgery are corrected, tooth compensation is removed, and the shape of the dental arch is adjusted. After the orthognathic surgery, post-operative orthodontics is carried out to finely adjust the occlusal relationship. This is also the most

common treatment mode for severe skeletal malocclusion at present. Pre-operative orthodontics plays an important role. Through pre-operative orthodontics, the occlusal interference points during surgery can be eliminated, the smooth movement of bone blocks during the orthognathic surgery can be ensured, the difficulty of the orthognathic surgery can be reduced, the segmentation of the jawbone can be reduced or avoided, the distance jaw movement can be exactly determined, and the patient's facial appearance can be improved to the greatest extent. However, there is a process of gradual deterioration of the patient's facial appearance at this stage. However, a retrospective study reported that about 1/3 patients considered pre-operative orthodontics is the most unbearable part of the whole treatment process, and the gradual deterioration of the facial appearance was the main reason.

The surgery first approach (SFA) means that patients do not receive any orthodontic treatment before orthognathic surgery or only receive simple orthodontic treatment for no more than 2 months. When using the SFA to correct severe skeletal deformities, the alignment of teeth, the matching of the upper and lower dental arches, and the leveling of curves are postponed. Therefore, it is more necessary to fully predict the distance of bone movement and the space for post-operative tooth decompensation. In addition, the final occlusion after the operation should have as many occlusal contact points as possible to facilitate the stability of the bone blocks after the operation. This approach requires repeated communication between orthodontists and orthognathic surgeons and strict control of the indications for SFA. Such cases often have the following characteristics: good arrangement/mild crowding; normal/mild occlusal problems of posterior teeth; flat vertical occlusal curve; normal or mild compensation of incisor periodontium, and incisors relative to the basal bone within the normal range; small transverse difference between the upper and lower dental arches; non-extraction cases are preferred as much as possible.

10 Expert Comments and Discussions

Professor Hu Min

For surgery first approach (SFA) cases, the indications need to be strictly screened, and the amount of tooth compensation should be clearly understood. When formulating the final occlusal relationship in SFA, the space for tooth movement should be predicted to achieve good treatment results. For example, in this case, the lower incisors have compensatory lingual inclination in the sagittal plane. After the surgery, to restore the normal angle of the lower incisors and level the lower anterior teeth, the lower incisors will move labially. Therefore, when formulating the final occlusal position, the amount of this movement should be predicted, resulting in an overjet of 5 mm in the final occlusion. Finally, a good overbite and overjet relationship was achieved after the orthodontic treatment. In addition, a clever point in this case is that the movement in the sagittal plane is not obvious, mainly focusing on "correcting the transversal asymmetry". Therefore, the impact on the upper and lower lips is not significant, and finally achieved satisfactory outcome.

Professor Wu Guomin

For patients with maxillary basal bone asymmetry, when designing the osteotomy line during surgery, a modified LeFort I osteotomy is generally used. The smaller side is changed to a high arc line, and bone grafting is performed above the high arc osteotomy line. The source of the bone graft is from the mandible or the medial side of the mandibular angle. In this way, the maxillary asymmetry can be improved.

Relatively speaking, there are more clinical cases of mandibular asymmetry. We have two general approaches. The first is bone grafting, and the second is to modify the osteotomy line. In the bone grafting approach, through digital analysis, we determine the defect area on the with side a deficiency and perform

bone grafting there. For bone grafting, the absorption rate is about 50%. However, even if 50% is absorbed, it still provides a good improvement in the facial appearance. In terms of modifying the osteotomy line, two methods are used to modify the asymmetrical area. If the asymmetrical area is in the mandibular body, the genioplasty osteotomy line is modified. The osteotomy line on the smaller side is moved posteriorly to the area of sagittal split osteotomy, that is, the mental foramen area. For patients with bilateral asymmetry in the mandibular angle area, we design a modified sagittal split osteotomy. The normal sagittal split osteotomy line starts from the mesial of the first or second mandibular molar, that is, the buccal shelf area. On the side with a smaller mandibular angle, we can move the osteotomy position anteriorly to the mental foramen area. After the sagittal split, the area from the mental foramen to the mandibular angle can be moved outward by about 3 - 4 mm as a whole. These amounts are quite significant for improving the asymmetry.

Professor Zhu Xianchun

For patients with facial asymmetry, whether it is orthodontic - orthognathic combined treatment or orthodontic camouflage treatment, there is a problem to whether remove the etiological factors, including patients' habits such as resting the chin on the hand, chewing on one side, and habitual head tilt. If the etiological factors of asymmetry are not removed, it will have a relatively obvious impact on relapse.

Among them, the asymmetric pulling force of the bilateral muscles has the most obvious impact on the relapse of asymmetry. Therefore, it can be considered that the time of wearing a stable occlusal splint after surgery should be relatively longer. At the same time, a stable occlusion after surgery is also beneficial for retention. When designing the retainer, the base of the retainer on the opposite side of the deviated side should appropriately be extended to resist the force of relapse .

Case 2

From Camouflage Orthodontics to Orthognathic Surgery: A Secondary Treatment Case of Skeletal Class III Malocclusion with Facial Asymmetry



Writer Information

Dr. Xiaoxi Wei

Associate Professor, Associate Chief
Physician, Master's Supervisor

Department of Orthodontics at the
Hospital of Stomatology Jilin University

01 General Information

A 23-year-old female patient presented with a chief complaint of facial asymmetry, long lower facial height and unsatisfactory occlusion for over a decade. Ten years ago, she received camouflage orthodontic treatment for crossbite with two mandibular premolars extracted. The crossbite was corrected after the first treatment. However, she noticed obvious facial asymmetry in adulthood and requested retreatment for aesthetic concerns. No relevant family history was reported.

02 Clinical Examination

● Facial Examination

Frontal view: Facial asymmetry with the right side fuller than the left. The chin point deviated to the right. The maxillary dental midline shifted left and the mandibular dental midline shifted right relative to the facial midline. Mandibular deviation occurred during mouth opening. The lower face was elongated, with the upper lip to lower lip height ratio less than 1:2.

Profile view: Concave facial profile, depressed nasal base and prominent chin. Both upper and lower lips lied posterior to the E-line. The incisal edge of maxillary incisors was behind the Gall-line, accompanied by an acute nasolabial angle and high mandibular plane angle.

● Intraoral Examination

Permanent dentition with two missing mandibular premolars. Bilateral molars were in full Class III relationship, and right canines presented distal relationship. Anterior overjet and overbite were normal. Compensatory dental changes were observed: mandibular incisors inclined lingually and maxillary incisors

inclined labially. The discrepancy between maxillary and mandibular dental midlines was 2.8 mm. The Spee curve was flat. Teeth 15 and 25 had caries, and multiple teeth showed existing restorations.

- Temporomandibular Joint (TMJ) Examination

Clicking sound was detected in the left TMJ during maximum mouth opening, without bilateral pain. The condition remained stable in the past six months.



03 Imaging Examination

- Panoramic Radiograph

Teeth #34 and #44 were absent. The root of tooth #35 was relatively short. Impacted teeth #18 and #28 were visible, while teeth #38 and #48 had fully erupted. Asymmetry was found in bilateral condylar morphology, and cone-beam computed tomography (CBCT) was ordered for further evaluation.

- Lateral Cephalogram

Skeletal growth was complete. Skeletal Class III malocclusion predominantly caused by maxillary hypoplasia. High mandibular plane angle and steep occlusal plane. Maxillary incisors inclined labially and mandibular incisors inclined lingually.

- Posteroanterior Cephalogram

The difference in bilateral facial prominence was 1.7 mm. The midline discrepancy between maxilla and mandible was 3.8 mm, and the dental midline discrepancy was 2.8 mm. The occlusal plane tilted by 2.6°, and the postural facial asymmetry was 2.9°.

- CBCT

The length difference between left and right mandibular ramus was 5.5 mm, and the height difference of bilateral mandibular bodies was 1.8 mm. The angle difference between bilateral mandibular angles was 9°, while the length of bilateral mandibular bodies was basically equal.

The roots of maxillary and mandibular incisors were short, and the labial alveolar bone of mandibular anterior teeth was thin. Bilateral condyles presented asymmetric morphology and tilted long-axis orientation. The anterior space of the left condyle increased with prominent lateral pole, and the cortical bone remained continuous.

- Arch Width Analysis

(1) **Dental arch width**

Maxilla: 40.1 mm (3-3), 41.2 mm (4-4), 52.6 mm (6-6)

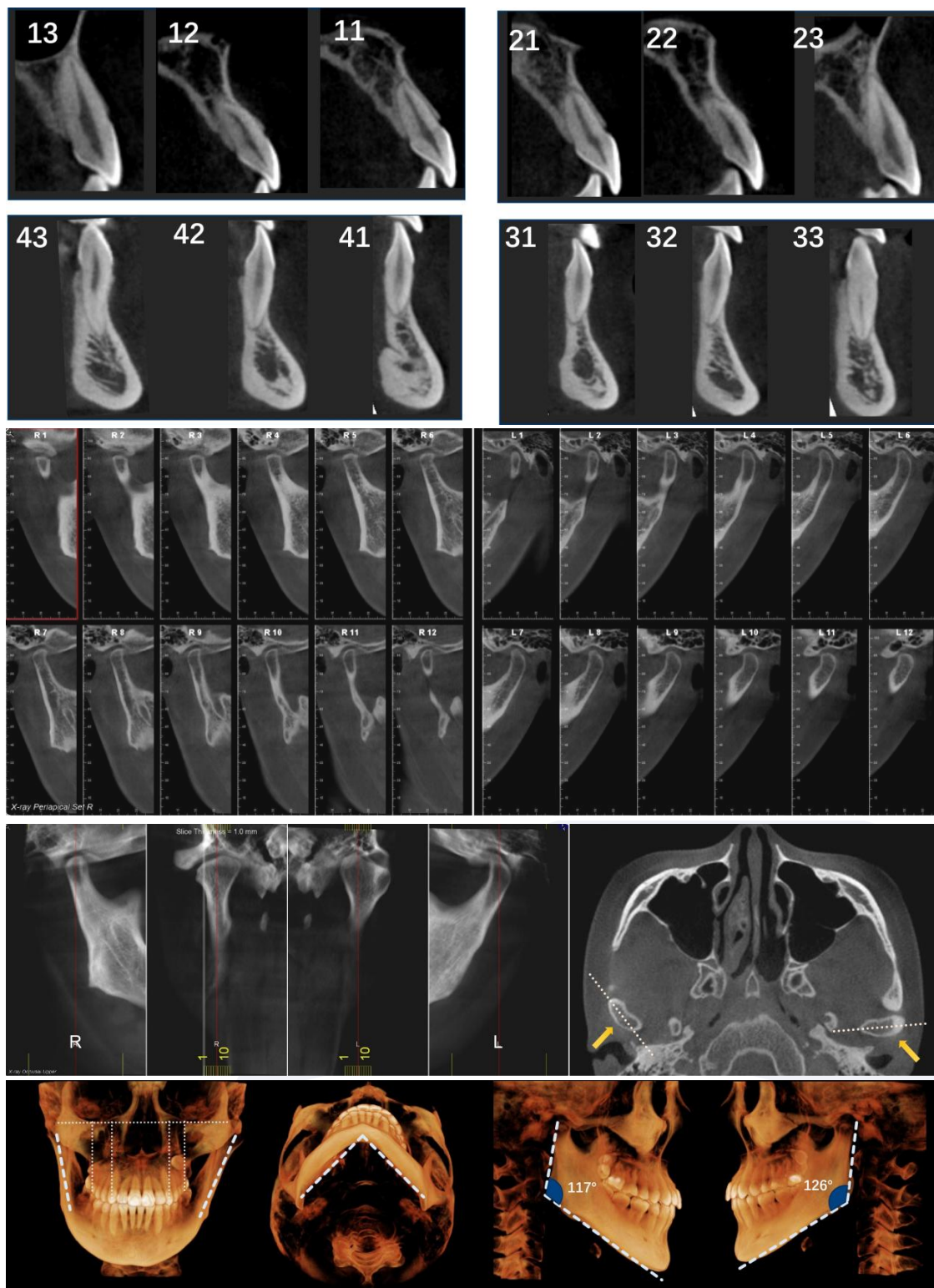
Mandible: 27.6 mm (3-3), 33.2 mm (5-5), 42.5 mm (6-6), 48.1 mm (7-7)

(2) **Basal bone width**

University of Pennsylvania CBCT transverse analysis: maxillary basal bone narrowness of approximately 0.54 mm.

Yonsei University CBCT transverse analysis: maxillary basal bone narrowness of approximately 0.11 mm.





04 Diagnosis

- ✧ Skeletal Class III malocclusion (mainly due to maxillary hypoplasia)
- ✧ Skeletal facial asymmetry (predominantly mandibular deviation)
- ✧ High-angle facial pattern
- ✧ Angle's Class III malocclusion

05 Treatment Objectives

Correct sagittal jaws discrepancy and mandibular deviation, improve long-face high-angle morphology, establish stable occlusion, and maintain TMJ function as well as periodontal and dental health.

06 Treatment Plan: Orthodontic-Orthognathic Combined Treatment

- (1) **Pre-surgical orthodontics:** Extract carious teeth 15 and 25. Align and level the dentition and dental arches. Use mini-implants to retract maxillary incisors and align the maxillary dental midline with the facial midline. Labialize mandibular anterior teeth to create reverse overjet preoperatively. Upright posterior teeth and adjust posterior tooth torque to decrease posterior overjet on the right side and increase that on the left side.
- (2) **Orthognathic surgery:** Maxillary Le Fort I osteotomy + bilateral sagittal split ramus osteotomy (BSSRO) + genioplasty
- (3) **Post-surgical orthodontics:** Finely adjust occlusion, close residual spaces, correct midlines, and refine anterior overjet/overbite and posterior intercusp relationship. Perform appropriate overcorrection and apply long-term retention.

07 Treatment Process

- Pre-surgical Orthodontics



Teeth 15 and 25 were extracted, and brackets were bonded. Please noted that further labial inclination of maxillary incisors should be prevented.



Alignment and leveling, and elimination of dental compensation for both arches.



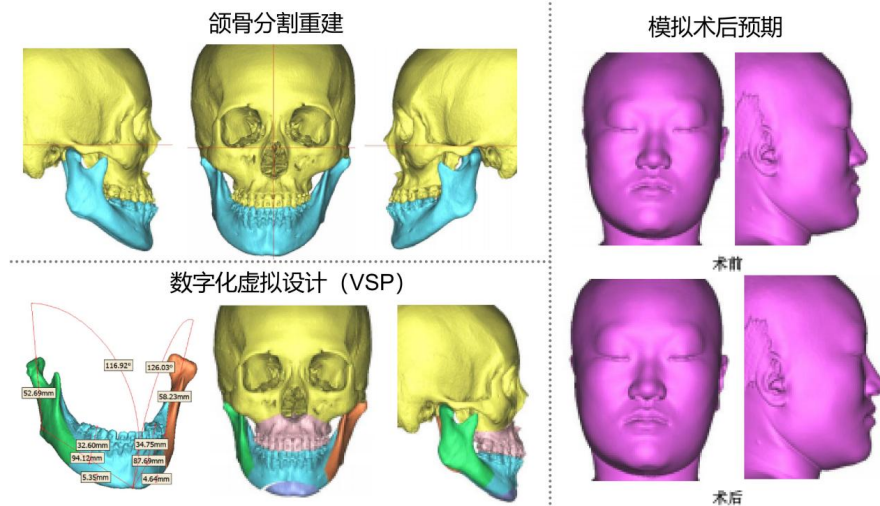
Mini-screws were placed in the maxilla for incisor retraction and vertical control, and the maxillary midline was adjusted to be consistent with the facial midline. A thin occlusal splint was placed in the late stage to separate occlusion. Mandibular anterior teeth were further labialized to form crossbite to reserve space for surgical movement.



Pre-surgical orthodontics lasted for 15 months. Expected decompensation was achieved, with temporary deterioration of facial profile and occlusion during this phase.

- Virtual Surgical Planning (VSP)

Digital segmentation, reconstruction and postoperative effect simulation were completed via virtual surgical planning.



- Post-surgical Orthodontics

Post-surgical orthodontics was initiated 1 month after surgery and completed within 7 months.



Residual spaces were used to correct midline deviation and finely adjust occlusal relationship.

08 Treatment Outcomes

Facial symmetry and proportionality were significantly improved. Mandibular deviation and long-face appearance were corrected, with proper incisor display during smiling. The concave profile was transformed into a straight profile, and the harmonious nasolabio-mental relationship was restored.

Intraorally, molars and canines achieved neutral occlusal relationship. The dentition was well-aligned with coincident dental midlines. Anterior overjet and overbite returned to normal, and posterior teeth presented stable intercuspal occlusion, fulfilling all orthodontic treatment goals.



Post-tx Facial and Intraoral Photos



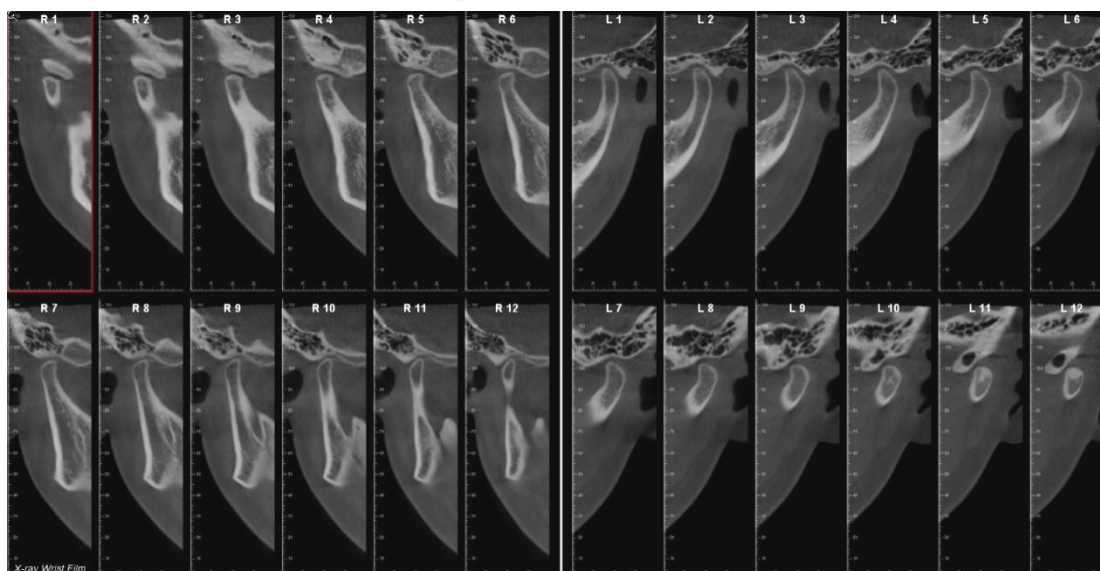
Post-tx Panoramic Radiograph and 3D Reconstructed CT Images

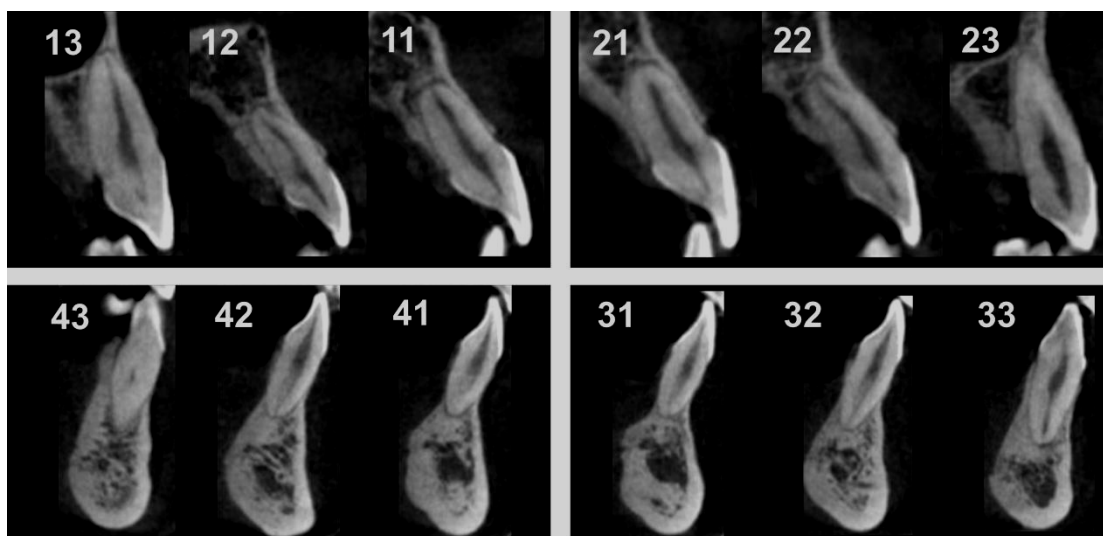
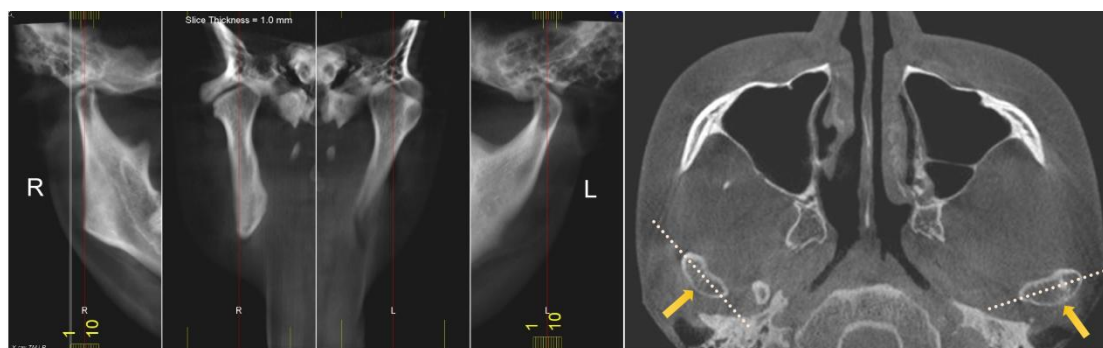
测量项目	正常值	治疗前	治疗后
Frontal Convexity, L (mm)	12.8±2.5	18.9	13.7
Frontal Convexity, R (mm)	12.8±2.5	20.6	13.4
Mx-Md Midline (mm)	0.0±2.0	3.8	0.4
Denture Midline Discrepancy (mm)	0.0±2.0	2.8	-0.1
Occlusal Plane Tilt (°)	0.0±2.0	-2.6	-1.1
Molar to Jaw, L (mm)	11.1±1.7	10.7	11.2
Molar to Jaw, R (mm)	11.1±1.7	9.8	10.0
Postural Symmetry (°)	0.0±2.0	-2.9	-0.7

Comparison of Posteroanterior Cephalometric Measurements between Pre-tx and Post-tx

测量项目	正常值	治疗前	治疗后
SNA	82.8±4.0	77.5	79.4
SNB	80.1±3.9	79.6	79.3
ANB	2.7±2.0	-2.1	0.1
MP-SN	33.1±5.6	39.1	34.9
MP-FH	28.0±4.0	36.8	32.4
U1-SN	105.0±6.0	111.0	105.2
U1-NA	4.3±2.7	9.9	6.6
L1-MP	94.0±6.0	71.7	84.5
L1-NB	4.0±1.8	2.5	3.8
Wits值	-1.0±1.0	-6.6	-2.3
Occ-SN	14.4±2.5	21.3	14.6

Comparison of Lateral Cephalometric Measurements between Pre-tx and Post-tx





Postoperative examination showed favorable condylar morphology, position and anterior alveolar bone conditions of incisors.

09 One-Year Follow-up

The treatment outcomes remained stable after one year of follow-up. The patient presented improved periodontal tissues, no adverse TMJ symptoms, stable occlusion and no recurrence of facial asymmetry.



10 Treatment Experience

● Tracing the Etiology of Skeletal Facial Asymmetry from Multiple Perspectives

- (1) Correlation between condylar dysplasia and temporomandibular disc function: Analyze the origin and timing of condylar asymmetry, and differentiate treatment strategies for congenital and acquired condylar dysplasia. Explore the causal relationship between disc displacement and condylar growth imbalance.
- (2) Secondary impacts of camouflage orthodontics on jaw development and TMJ: Compensatory tooth movement alters the biomechanical environment of the TMJ. Artificial occlusal adjustment may cause unbalanced stress on condyles within the glenoid fossa and further aggravate condylar asymmetry. It is necessary to judge whether dental compensation exceeds the physiological limit of adaptation and remodeling.
- (3) Combined effects of genetic and environmental factors: Genetic factors determine the growth potential and severity of jaw deformities. Environmental factors including unilateral mastication, occlusal interference and trauma can exacerbate deformities on a genetic basis. Clinically, skeletal Class III malocclusion is frequently accompanied by facial asymmetry, while skeletal Class III malocclusion tends to associate with open bite. Superimposed multiple malocclusions will complicate the etiology.
- (4) Influence of condylar morphology and position on long-term stability: Asymmetric condylar morphology and axial orientation are major risk factors for postoperative recurrence of skeletal facial asymmetry. The biomechanical matching between condyle and fossa affects postoperative jaw remodeling. Stress concentration may lead to secondary condylar resorption or hyperplasia. Human adaptive remodeling capacity, as well as the mutual promotion between TMJ function and occlusal stability, should be fully considered. Stable intercuspal occlusion plays a vital role in maintaining long-term TMJ stability and adaptive remodeling.

● Application of ⁹⁹Tc-MDP Radionuclide Bone Imaging in the Diagnosis and Treatment of Facial Asymmetry

- ✧ **Principle:** ⁹⁹Tc-MDP binds to hydroxyapatite. Areas with active osteogenesis present hot spots, which reflect bone metabolism and blood perfusion.
- ✧ **Advantages and limitations:** This technique is sensitive for early detection and can provide metabolic information unavailable by conventional imaging, yet it has limited specificity. Hot spots can also be observed in inflammation, tissue repair and tumor lesions.
- ✧ **Gold standard:** SPECT/CT fusion imaging, which accurately correlates metabolic hot spots with anatomical structures.
- ✧ **Clinical application:** It is mainly used to assess the growth activity of condylar hyperplasia or resorption, determine the optimal timing for facial asymmetry surgery, and monitor long-term treatment efficacy. For adolescent patients with facial asymmetry caused by condylar dysplasia, this examination provides critical evidence for selecting growth modification or surgical treatment timing.

- **Precise Design and Multidisciplinary Cooperation for Retreatment Cases with Combined Orthodontic-Orthognathic Therapy**

- (1) Define the clinical boundary between camouflage orthodontics and orthognathic surgery to avoid scheme adjustment during treatment.
- (2) Unify the treatment objectives of orthodontists and orthognathic surgeons to eliminate interdisciplinary misunderstandings.
- (3) Implement digital virtual surgical planning (VSP) in clinical practice.
- (4) Analyze the influences of surgical approaches and operation timing on treatment outcomes.
- (5) Master the appropriate degree of overcorrection to ensure long-term stability.
- (6) Comprehensively evaluate periodontal status, TMJ condition, airway patency and psychological factors for retreatment cases.

11. Expert Comments and Discussions

- **Professor Wu Guomin**

Q1: How to determine the appropriate treatment timing for adolescents with facial asymmetry or crossbite unfit for surgery?

Answer: First, identify the origin and nature of facial asymmetry. Early intervention is recommended for cases caused by functional factors such as occlusal interference and bad oral habits. For patients with a family history suggestive of hereditary skeletal asymmetry, regular observation is advised until the late growth stage. If the skeletal deformity is mild and within the scope of physiological dental compensation with acceptable facial appearance, camouflage orthodontics can be performed. For moderate to severe skeletal malocclusion beyond dental adaptive capacity or patients with high aesthetic demands, combined orthodontic-orthognathic treatment is indicated.

Q2: The patient still presented an insufficient depth of the labiomental sulcus after treatment. This was mainly because the prior mandibular compensatory treatment limited complete decompensation during presurgical orthodontics. Whether further mandibular setback during surgery could yield a better outcome?

Answer: This case was characterized by skeletal Class III malocclusion dominated by maxillary hypoplasia, while mandibular development was basically normal. Therefore, the surgical plan focused primarily on maxillary advancement. Besides, periodontal conditions restricted full labial inclination of mandibular anterior teeth during decompensation. If periodontally accelerated osteogenic orthodontics (PAOO) had been performed preoperatively to augment labial alveolar bone, a larger range of labial movement for mandibular anterior teeth could be achieved, creating more space for mandibular repositioning in surgery.

Q3: Considerations for intraoperative midline overcorrection during surgery in facial asymmetry patients?

Answer: The shorter condyle is positioned posteriorly in the glenoid fossa with an enlarged anterior space, while the contralateral condyle lies centrally or anteriorly. The side with the shorter condyle has a higher

recurrence risk due to postoperative muscle traction. Therefore, slight intraoperative midline overcorrection is applied to reserve allowance for potential recurrence.

● Professor Hu Min

(1) Nowadays, secondary treatment cases are on the rise, which poses greater challenges and higher requirements for orthodontists in terms of clear clinical thinking and presurgical orthodontic techniques. A key factor for the favorable outcome of this case was that no premolars were extracted in the maxilla during primary camouflage treatment, leaving adequate space for premolar extraction, retraction and decompensation in retreatment. Maxillary premolar extraction in the first round would severely restrict sagittal movement and increase the difficulty of pre-surgical orthodontics.

(2) For adolescents in the peak growth period with anterior disc displacement and condylar resorption, early disc repositioning surgery is recommended to facilitate normal condylar growth and development.

(3) ⁹⁹Tc-MDP radionuclide imaging serves as an important reference for the initial diagnosis, surgical timing selection and long-term stability evaluation of patients with facial asymmetry. Orthodontists are advised to pay attention to and properly apply this examination in clinical practice.

● Professor Zhu Xianchun

Q: Skeletal Class III patients with facial asymmetry usually present sagittal and transverse arch discrepancies. Posterior palatal cusp drooping and limited torque control are common obstacles during pre-surgical arch width adjustment. How to deal with this problem during the pre-surgical orthodontics?

Answer: If posterior teeth show overall elongation, mini-implants or other methods can be used for intrusion. If interlocking cuspal relationship restricts torque expression, occlusal separation is adopted to eliminate occlusal interference. Complete posterior tooth torque decompensation is hard to achieve preoperatively. Residual torque adjustment can be arranged in post-surgical orthodontics as long as it does not interfere with jaw movement. Alternatively, preset crown-lingual torque on maxillary stabilizing archwires can be applied preoperatively, taking advantage of active bone remodeling in the early postoperative period to achieve ideal torque.

● Discussion by Professor Bao Xingfu and Other Experts

Q1: Orthodontic or orthognathic Solutions for excessive labial inclination of maxillary anterior teeth in retreatment cases?

Answer:

(1) Extract maxillary premolars for retraction and decompensation if no maxillary teeth were extracted in primary treatment.

(2) If maxillary premolars have been extracted previously, use mini-implants for enhanced anchorage to achieve distalization and retraction of the whole maxillary arch, though the effect is limited by anatomical boundaries.

(3) Perform slight maxillary clockwise rotation during orthognathic surgery.

(4) Apply segmented osteotomy or anterior subapical osteotomy to rotate the anterior maxilla clockwise and correct incisor labial inclination.

Q2: Vertical considerations and surgical volume determination for patients requiring intraoperative maxillary counter-rotation?

Answer: Maxillary positioning is the core of surgical design. Counter-rotation is mostly applied in skeletal Class II cases. For individual skeletal Class III cases like this one, it is used to reduce lower facial height and incisor display. However, maxillary counter-rotation may deepen midfacial concavity. Autologous bone graft harvested from mandibular setback can be used to augment the nasal base area. During pre-surgical orthodontics, maxillary incisors should be kept relatively upright, so that ideal axial inclination can be obtained via intraoperative counter-rotation. In addition, proper mandibular counter-rotation or advancement can expand the airway volume for patients with airway stenosis.

Q3: Precautions for intermaxillary elastic traction in post-surgical orthodontics?

Answer: Short-distance or vertical traction helps stabilize occlusion and correct mild sagittal discrepancy. Long-distance asymmetric traction should be strictly avoided in facial asymmetry patients, as it may cause secondary occlusal plane tilt. Surgical approaches also influence bone segment stability; segmented osteotomy is more susceptible to traction force compared with integral jaw osteotomy. Rational use of postoperative occlusal splints and anchoring elastic chains on mini-screws may reduce adverse effects of traction on natural teeth.

Q4: Optimal timing for the third molar extraction before surgery?

Answer: For Class III patients, mesial tipping of mandibular third molars may assist labial movement of mandibular anterior teeth to some extent during pre-surgical decompensation. Extraction too close to or even during the surgery will lead to incomplete alveolar bone healing and increase the risk of mandibular angle fracture. Clinically, it is recommended to extract mandibular third molars 3 to 6 months before surgery.

Reference

1. Bishara SE, Burkey PS, Kharouf JG. Dental and facial asymmetries: a review. *Angle Orthod.* 1994;64(2):89-98.
2. Thiesen G, Gribel BF, Freitas MPM. Facial asymmetry: a current review. *Dental Press J Orthod.* 2015;20(6):110-25.
3. Almeida LE, Zacharias J, Pierce S. Condylar hyperplasia: an updated review of the literature. *Korean J Orthod.* 2015;45(6):333-40.

4. Wolford LM, Movahed R, Perez DE. A classification system for conditions causing condylar hyperplasia. *J Oral Maxillofac Surg.* 2014;72(3):567-95.
5. Riechmann M, Gellrich NC, Kress B, Schmidt C, Schröder C, Neff A. Clinical practice guideline: condylar hyperplasia of the mandible—diagnosis and treatment. *Dtsch Arztebl Int.* 2024;121(24):816-23.
6. Wen B, Shen Y, Wang CY. Clinical value of 99Tcm-MDP SPECT bone scintigraphy in the diagnosis of unilateral condylar hyperplasia. *Scientific World Journal.* 2014;2014:256256.
7. Karssemaekers LHE, Nolte JW, Rehmann C, Raijmakers PG, Becking AG. Diagnostic performance of SPECT-CT imaging in unilateral condylar hyperplasia. *Int J Oral Maxillofac Surg.* 2023;52(2):199-204.
8. 张冠凝, 刘艺, 李雯玥, 范甜甜, 王佳, 赵震锦. 成人骨性错牙合畸形患者社会心理及人格特征与治疗方案选择的相关性研究. *华西口腔医学杂志.* 2020;38(3):308–13.
9. 骆丹锋, 魏晓曦, 胡敏. 心理因素在颞下颌关节紊乱病诊疗中作用的研究进展. *中华口腔医学杂志.* 2020;55(10):794-798.
10. Karssemaekers LHE, Besseling LMP, Schoonmade LJ, Su N, Nolte JW, Raijmakers PG, Becking AG. Diagnostic accuracy of bone SPECT and SPECT/CT imaging in the diagnosis of unilateral condylar hyperplasia: a systematic review and meta-analysis. *J Craniomaxillofac Surg.* 2024;52(4):447-53.
11. Chow L, Goonewardene MS, Cook R, Firth MJ. Adult orthodontic retreatment: a survey of patient profiles and original treatment failings. *Am J Orthod Dentofacial Orthop.* 2020;158(3):371-82.
12. Zhang MJ, Sang YH, Tang ZH. Psychological impact and perceptions of orthodontic treatment of adult patients with different motivations. *Am J Orthod Dentofacial Orthop.* 2023;164(3):e64-e71.
13. Ko EWC, Huang CS, Lin CH, Chen YR. Orthodontic perspective for face asymmetry correction. *Symmetry.* 2022;14(9):1822.
14. Kim YJ, Kim MY, Jha N, Jung MH, Kwon YD, Shin HG, Ko MJ, Jun SH. Treatment outcome and long-term stability of orthognathic surgery for facial asymmetry: a systematic review and meta-analysis. *Korean J Orthod.* 2024;54(2):89-107.
15. 聂萍, 姜宁, 丁琴凤, 张雷, 蔡鸣, 朱敏, 王旭东. 24 例骨性Ⅲ类伴偏颌畸形患者隐形正畸-正颌联合治疗效果分析. *上海口腔医学.* 2022;31(1):62–6.
16. Hosseinzadeh Nik T, Gholamrezaei E, Keshvad MA. Facial asymmetry correction: from conventional orthognathic treatment to surgery-first approach. *J Dent Res Dent Clin Dent Prospects.* 2019;13(4):311-20.