IOF International Orthodontics Foundation Clinical Showcase

LEARNING & REFLECTION

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Orthodontics Department, Seoul National University School of Dentistry

Writer Information

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Dr. Ma completed his doctoral degree and received Orthodontics DDS from the School of Dentistry, Capital Medical University in 2008, then worked as an attending physician at the Department of Orthodontics, Beijing Stomatological Hospital. He participated the ADA Forsyth Institute as a post-doc visiting researcher from 2020-2022, in which received an orthodontic-microbiological research training. Dr. Ma is also a young committee member of Chinese Orthodontic Society.

Clinical Showcase Stop 9 Learning & Reflection
Topic: From Biomechanics to Complex TMJ Cases

With the moderation of the President of the Korean Orthodontic Society Prof. Dr. Seung-Hak Baek, from the College of Dentistry, Seoul National University, this IOF clinical showcase was presented by four residents at Seoul National University (SNU). After each case presentation, Professor Dr. Il-Hyung Yang and Professor Dr. Jung-Sub An from SNU moderated the discussion session. Focusing on the main topic "From biomechanics to Orthodontic treatment of complex temporomandibular joint problems", each of the four speakers reported one case of an impacted maxillary canine adjacent to first premolar, an orthognathic surgery-combined treatment for skeletal Class II patient with TMD, a tongue crib treatment for openbite with parafunctional oral habit, and a staged management of recurrent unilateral TMJ ankylosis from childhood to young adulthood, respectively.

Case 1

Management of an impacted maxillary canine adjacent to first premolar: A case report

Speaker: Dr. Jinoh Son

01.Case summary

A 12-year-old boy complained of unerupted upper left teeth referral from Pediatric Dentistry Department. Extraoral examination showed mild protrusive profile without asymmetry. Intraoral examination showed Class II molar and canine relationships on both sides, deep overbite and overjet, tooth 63 prolonged retention and absent of tooth 23, mild crowding on both jaws, and upper midline shifted to the left. Cephalometric analysis illustrated that patient had a skeletal class II tendency (ANB = 5.18°) with maxillary protrusion (SNA=87.74°) and hypodivergent pattern (FMA=22.45°), proclined upper incisors and upright lower incisors. Posterior-anterior cephalgram showed asymmetric mandible with chin point shifted to the right. Panoramic and CBCT showed tooth 23 vertically impacted above the root apex of tooth 24, the root of 23 a little distally inclined. Root resorption of 24 could be seen on the apical region.

02.Problem list

Skeletal:

- Skeletal Class II
- Hypodivergent pattern

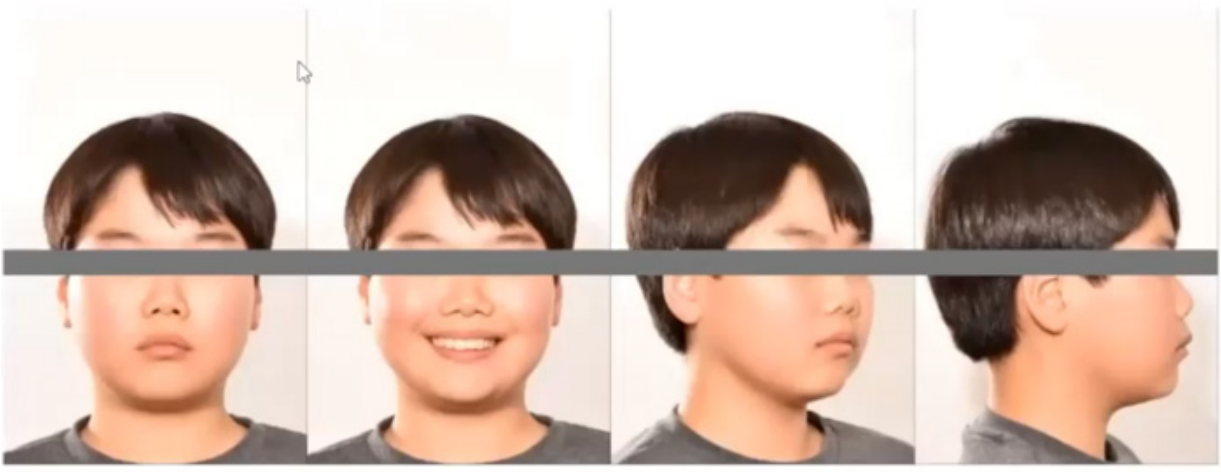
Dental:

- Class II molar and canine key
- Upper incisor: Labioversion
- Lower incisor: Normoversion
- Impacted tooth: #23 (above the 24 apex)
- Prolonged retention: #63
- Root resorption: #24

Soft tissue and other problems:

- n/s

Pretreatment record



- Class II molar and canine key
- Large overjet
- Deep overbite
- Prolonged retention: #63
- Lower anterior crowding

03.Treatment objectives

Phase I: # 23 traction

1.Window opening of #23, traction mesially away from #24 on stage I then occlusal traction on stage II.

2.Deciduous tooth #65 extraction

3.Triple tube welded band on upper first molar for distalization of upper molars with cervical headgear, and customized traction arm for #23 traction.

4.#24 angulation control during alignment on upper arch

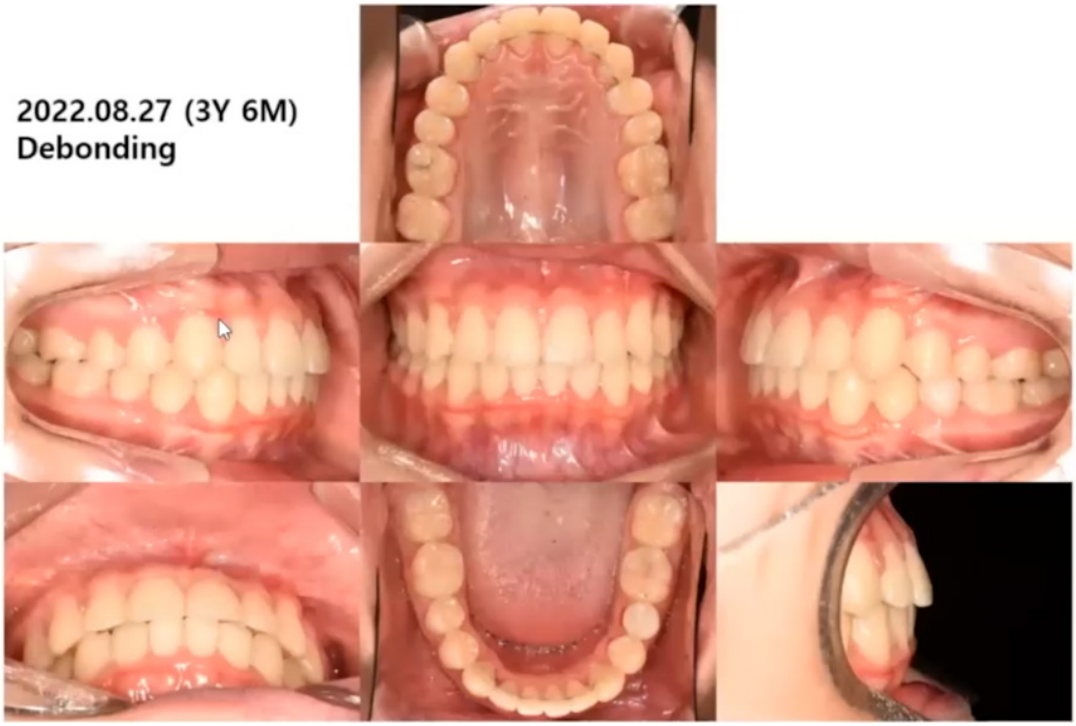
5.Reassessment after #23 traction: traction failure, gingival recession, root resorption and possibility of premolar extraction on phase II.

04.Treatment process

- Window opening and closed eruption during #23 mesially traction away from the root of #24, while cervical headgear was applied for molar distalization.
- #23 moved away from the root of #24 but erupted above mucogingival junction at 10 months. As #23 came out, #63 was extracted and #23 was dragged with elastic tie to the occlusal direction and aligned with labial arch wire. There was lack of attached gingiva on labial side of #23 due to exposure above mucogingival junction.
- Further reassessment was performed, and the treatment plan of phase II was non-extraction orthodontic treatment. Modified fixed anterior bite plate was applied for deep bite correction and laterally elastic traction of #23.
- Double key loops were bended to adjust #23 root torque laterally. Inflammatory gingiva of #23 was alleviated and improved by reconstruction of attached gingiva.
- After a total of 3 years and 6 months treatment, #23 managed to erupt and well aligned by traction. Correction of deep overbite and overjet was achieved, Class I relationships on both sides were built, and profile was improved.

Fixed orthodontic stage after 23 traction

Posttreatment record



05.Discussion and learning

[1] Treatment options of maxillary canine: open eruption vs closed eruption

There are many options for the treatment of the maxillary impacted canine adjacent to the first premolar. The key factors for successful traction of the impacted canine are accurately tooth locating from pretreatment CBCT, correct traction direction and proper biomechanics. According to the profile, sagittal and vertical skeletal pattern, the treatment option of impacted canine could be canine traction, canine-premolar translocation and extraction. In terms of the approaches of canine traction, open eruption and closed eruption can be selected, depending on different tooth location and the traction path for eruption.

For palatally impacted canine, preorthodontic uncovering and autonomous eruption has been suggested. This method has a benefit that it can be performed early, during the mixed dentition, so that the palatally displaced canine will be fully erupted into the palate. Closed surgical exposure is the other option but with several disadvantages. One disadvantage of this technique is that the crown of the canine is still buried beneath the palatal bone. When a force is placed on the canine, it pulls the crown against the bone. This can result in the creation of an alveolar defect distal to the lateral incisor and on the mesial and distal sides of the canine. A second disadvantage of early traction of a palatally displaced canine after surgical uncovering is the potential for root resorption on the lingual aspect of the lateral incisor. A third potential disadvantage with surgical uncovering and early traction is that the canine might not respond initially to the orthodontic force.

For buccally impacted canine, there are 3 techniques for uncovering a labially impacted maxillary canine: excisional uncovering, apically positioned flap, and closed eruption techniques. Orthodontists should assess the labiolingual position of the impacted canine crown, the vertical position of the tooth relative to the mucogingival junction, the amount of gingiva in the area of the impacted tooth, and the amount of gingiva in the area of the impacted canine. If the crown is positioned apical to the mucogingival junction, both excisional uncovering and apically positioned flap are improper. Closed surgical traction could be an idealtreatment method to make canine erupt from attached gingiva and enhance the gingival aesthetics.

[2] Case discussion

For this individual case, Dr. Jinoh Son considered that the patient had a hypodivergent vertical pattern and mandibular growth potential. This is the reason why his treatment option was non-extraction treatment with cervical headgear. In phase I, the closed traction of impacted #23 was brought mesially and then occlusally. During the mesial traction, the direction of force vector had a buccal component force, which is the reason for the buccal eruption of #23 above the mucogingival junction. After early eruption, the closed surgical traction transformed into open traction. Therefore, in phase II treatment, the use of a palatal arm on modified anterior bite plate could dragged the erupted canine to the palatal side. In the final adjustment stage, wire bending could also precisely correct the torque of canine by moving the root of canine to the palatal side. These operations had successfully improved the labial aesthetics of gingiva.

Dr. Yang then asked whether it is feasible to make translocation of the canine and the first premolars, since the roots of the canine slightly inclined to the distal. As Dr. Son answered, translocation of #23 and #24 was a feasible option for this case, which might much reduce the difficulty of traction of this vertically impacted canine. However, translocation could also lead to the loss of canine protection if the first premolar moves to the canine site. In addition, moving the root of #23 to palatal side needs confirmation by a CBCT scan, because the crown can also move buccally under the activation of extra torque from bending loops. If gingival aesthetics has not improved by post eruption positioning, additional periodontal surgery such as attached gingival graft can be performed.

Case 2

Orthognathic surgery-combined treatment for skeletal Class II patient with TMD

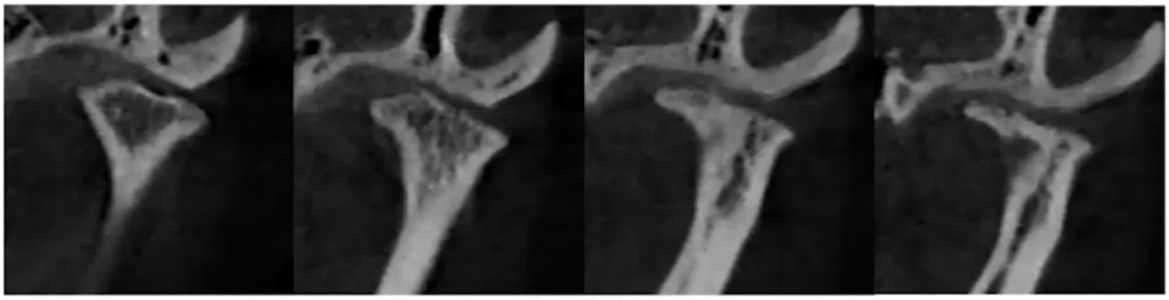
Speaker: Dr. Haeddeuri Kim

01.Case summary

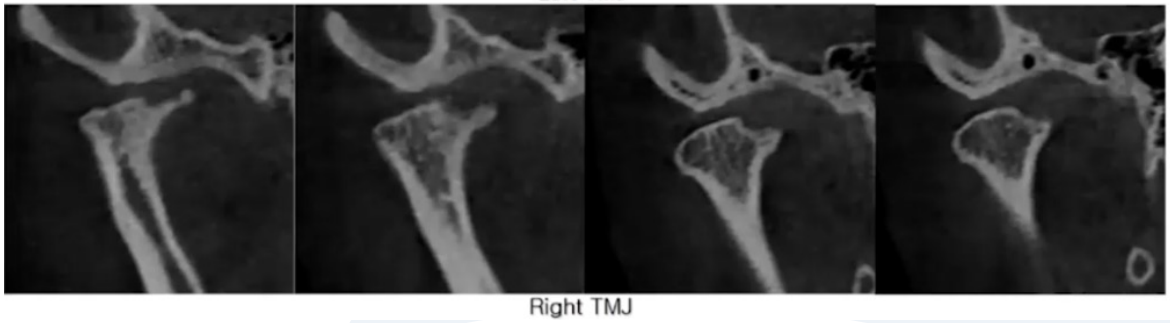
A 34-year-old female complained of protrusive lips. She had received orthodontic treatment 20 years ago. Extraoral examination showed prominent protrusive with lips incompetence and retrognathic chin. Intraoral examination showed Class II molar and canine relationships on both sides, deep overbite and overjet, lower midline shifted to the right. The second molars on both sides were scissor bite. Cephalometric analysis illustrated that patient had a severe skeletal class II tendency (ANB = 13.21°) and hyperdivergent pattern (FMA=40.44°), upright upper incisors (U1-SN=97.32°)and flared lower incisors (IMPA=104.01°). Posterior-anterior cephalogram showed asymmetric mandible with chin point shifted to the left. Bilateral condyle absorption was clearly flattened from OPG and CBCT, and MRI showed bilateral anterior disk displacement.

Pre-treatment records

Measurement	Mean	Pre-treatment
SNA	81.08	84.47
SNB	78.01	71.26
ANB	3.45	13.21
A-N per	0.40	7.52
Pog-N Per	-1.80	-21.53
FMA	29.63	40.44
Gonial angle	124.31	123.15
U1 to SN	105.28	97.32
IMPA	91.62	104.01
Interincisor angle	125.44	106.69
ODI	72.00	76.32
APDI	85.74	65.99



Left TMJ



Right TMJ

02.Problem list

Skeletal:

- Skeletal Class II
- Hyperdivergent pattern
- Facial asymmetry

Dental:

- Class II molar and canine
- Upper incisor: Linguoversion
- Lower incisor: Labioversion
- #17, 27, 37, 47: Scissor bite

Soft tissue and other problems:

- Both TMJ: Disc displacement without reduction

03.Diagnosis and treatment plan: Surgical orthodontic treatment

1.TMJ evaluation and treatment (CR splint)

Diagnosis: Disc displacement without reduction that needs to stabilize the TMJs before orthodontic treatment and surgery.

2.#18, 28, 38, 48 extraction

3.Presurgical orthodontics

1)#34, 44 extraction and mandibular space closure
2)Scissor bite correction by cross elastics
3)Surgery plan: Anterior segmental osteotomy (ASO) with #14, 24 extraction

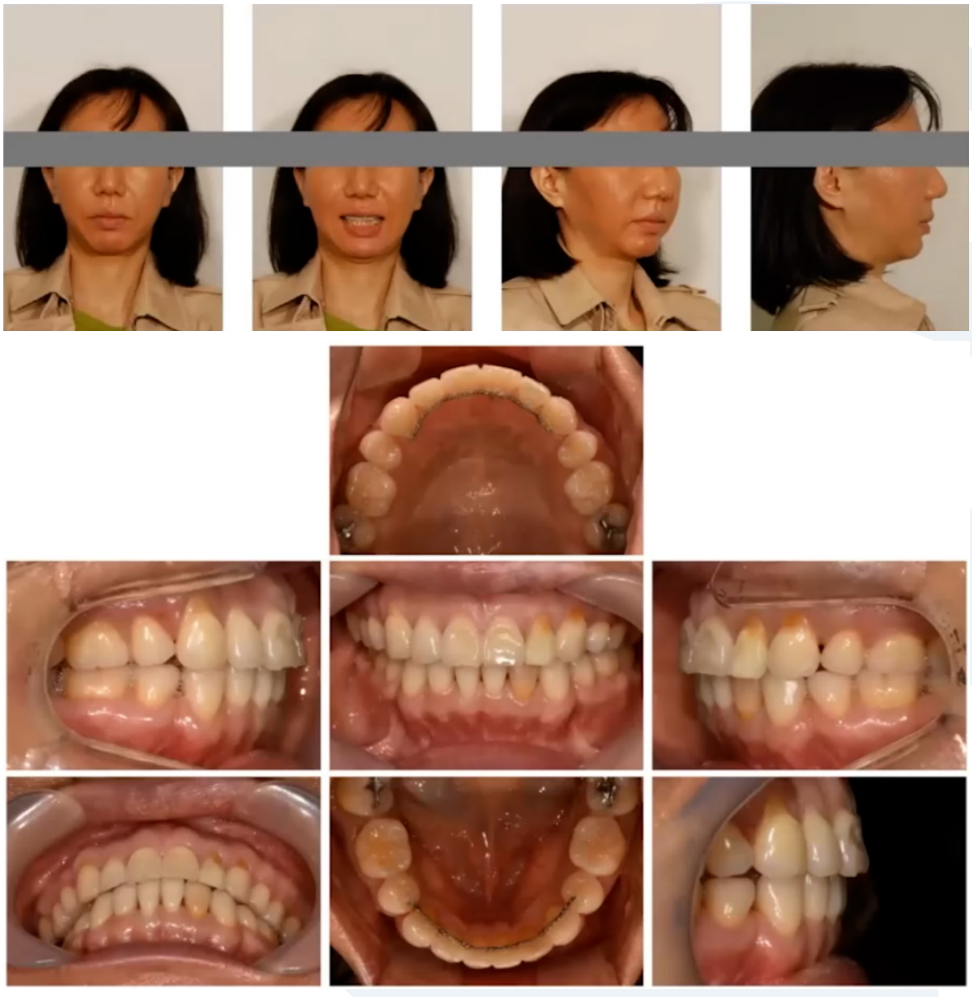
4.Orthognathic surgery

1)Maxilla Lefort I osteotomy + ASO
2)Mandible autorotation
3)Chin advanced genioplasty

5.Postsurgical orthodontics

6.Debonding and retention

Post-treatment records



Measurement	Mean	Post-operative	Debonding
SNA	81.08	78.2	78
SNB	78.01	71.44	71.16
ANB	3.45	6.76	6.84
A-N per	0.40	0.75	1.06
Pog-N Per	-1.80	-16.94	-17.64
FMA	29.63	40.32	39.89
Gonial angle	124.31	122.32	122.33
U1 to SN	105.28	95.03	93.28
IMPA	91.62	92.47	92.28
Interincisor angle	125.44	119.79	120.72
ODI	72.00	64.26	65.37
APDI	85.74	73.87	73.22

04.Treatment process

This patient had an irreversible anterior displacement of bilateral TMJ. CR placement plates were used to stabilize the TMJ position for 12 months before orthognathic surgery. Orthodontic treatment began at 3 months after the symptoms of TMJ were relieved and the position was stable. Correction of bilateral second molar scissor bite was performed before surgery and decompensation of lower incisors was achieved by extraction of 34, 44. During orthognathic surgery, extraction of 14 and 24 were simutaneously performed. Maxilla Lefort I osteotomy with ASO was adopted. The anterior maxilla part was moved back to close the extraction space 14 and 24. Before orthognathic surgery, mushroom archwire was used to increase the canine width to match the uneven width between canine and second premolarsk. The mandible auto-rotatation in counterclockwise was designed and conducted. Post-operative orthodontic treatment mainly achieved stable occlusion by closing remaining extraction space and intermaxillary elastics. Finally, the chin was anteriorly moved by 6mm, and the Class II facial and skeletal pattern was significantly improved after treatment. Normal anterior OB and OJ was established and the maxillary protrusion and the retrognathic chin were corrected. The occlusion and TMJ condition remained stable for 3 years.

05.Discussion and learning

[1] Risks of host factors and pre-operative TMJ treatment for Class II surgery patients

Patients with skeletal class II malocclusion have shown a high incidence of internal derangement (anterior disc displacement or other TMJ pathologies). These TMJ disorder patients usually have a specific skeletal morphology, such as backward positioning of the ramus and mandible, decreased posterior facial height, steep mandibular plane and facial asymmetry. The above skeletal and facial morphology is highly associated with mandibular relapse, which derived from condylar resorption related to TMJ internal derangment. It is recommended that patients should be given explicit preoperative information on the risk of condylar resorption with skeletal relapse with specific characteristics including young female, mandibular hypoplasia, posteriorily inclined condylar neck, high mandibular plane angle, short posterior facial height, and small posterior to anterior facial height ratio.

For these TMJ high risk patients, the TMJ health is of prime importance for stable results in orthodontic treatment and orthognathic surgery. It is crutial for determination of disc displacement status thriugh MRI and periodically take TMJ CT scan to verify the current condition of TMJs are stable. The unstable occlusion produces increased compression, resorption of TMJ condyle. Unstable TMJ status is then very likely to lead to mandibular relapse after surgery, which is associated with continuous condylar resorption and disc displacement. Degenerative changes in the condyle then play an important part in mandibular relapses, but the biomechanical changes that influence the length of the oral muscles

following mandibular advancement are also a significant factor. Patients with disc displacement are recommended to undergo procedures that stabilize the TMJs before orthognathic surgery. These procedures includes symptomatic therapy, pharmacotherapy, injection therapy and CR splint. Once disc displacement is corrected, a good pre-operative occlusion is much likely to achieve. In pre-surgical orthodontics, a good postoperative occlusal relationship is the main objective. However, long-term application of Class II elastics may lead to the hypertrophy of the retrodiscal soft tissue in the postarticular space, which gradually becomes thin out in the postcondylar space after surgery, and the condyle is gradually repositioned posteriorly. Therefore, Class II elastics should be applied very carefully throughout.

[2] Prevention of condyle sagging during surgical procedure is critical for stability.

For skeletal Class II orthognathic surgery patients, orthodontists should try their best to achieve a stable pre-operative occlusion, and the post-operative orthodontics should achieve a stable occlusal relationship and require long-term follow-up revisits. It is essential to assess the amount of mandibular advancement when making a surgery plan. If the surgery does not involve a large number of mandible advancement, it will be easier to manipulate and reposition the proximal segment. Unlimiting mandibular advancement is the most critical contributor to relapse. A large amount of mandibular advancement can lead to mechanical stress on condyle-disc complex and stretching of the mandibular muscles, which is unhealthy and unstable for TMJ. Therefore, the amount of mandibular advancement should be minimized. In this patient, a maxillary Lefort I setback osteotomy and anterior segmental osteotomy, as well as a genioplasty was performed to minimize mandibular advancement. Mandibular counterclockwise auto-rotation was therefore achieved without BSSRO which is good for TMJ stability. In this patient, a 6 mm mandibular advancement is not harmful for TMJ stability.

All the above surgical designing are considered making a post-operative balance on TMJ to prevent relapse. In addition, when performing orthognathic surgery, intra-operative management of TMJ status is also very important. Condylar heads should be passively settled into the glenoid fossa during surgery, ortherwise it leads to condylar displacement called condyle sagging. Condyle sagging is that the condyle is positioned inferiorly or anteriorly to the glenoid fossa, it is unstable to support the mandible in the new advanced position defined by the surgeon. The musclular pull tends to return the proximal segment to its original inclination, resulting in posterior movement of the chin. Condyle sagging may be caused by many factors. Incorrect occlusal position may be the main cause of condylar deviation during surgery, other reasons such as muscle and ligament stress, inflammation or edema in the joint can also cause condyle sagging. If condyle sagging is determined to occur after surgery, the removal of the screws from the distal and proximal bone segment can help treat and reposition of condyle.

Case 3

Tongue crib treatment for open bite patients with parafunctional oral habits

Speaker: Dr. Jinbeom Kim

01.Etiology of anterior open bite

Anterior open bite can be divided into two types, dental and skeletal open bite. Dental open bite refers to the insufficient height of anterior alveolar process, with or without excessive height of alveolar process in the posterior region. Skeletal open bite is usually accompanied by a dolichofacial growth pattern, enlargement of the interbase and gonial angles, enlargement of anterior facial height, and anteinclination of the maxilla. Functional etiologic factors for anterior open bite can be classified into three broad categories, including digit sucking habits, abnormal size and function of the tongue, and vertical growth pattern. Anterior positioning of tongue during swallowing in setting of anterior open bite may be a functional adaptation to form anterior oral seal. Parafunctional oral habits of finger sucking and tongue swallowing in childhood may contribute to dental and skeletal abnormalities, such as anterior open bite, increased overjet, hyperdivergent growth pattern and long facial height.

02.Treatment effect of tongue crib

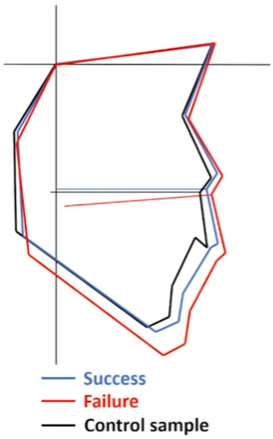
Methods to prevent the malocclusion induced by parafunctional oral habits usually include reminder therapy (response prevention therapy) such as gloves, thumb-guards, bandages, hot and bitter tastants applied to fingers. Orthodontic intervention devices are usually tongue cribs, which are removable or fixed in the upper jaw and extend cribs down to the incisor of the lower jaw from the upper palatal part of appliance. Tongue crib can be used to prevent anterior position of tongue during swallowing and digit sucking habits. It can usually block abnormal forces causes by parafunctional habits and achieve improvement in the alignment of teeth within 3 months and completely close the anterior open bite within about 6 months.

Dr. Jinbeom Kim then introduced their clinical research of treatment effects of tongue crib appliance. To find out what kind of treatment effect resolves anterior open bite, their research group tried to find a cephalometric variable related to the treatment effects of tongue crib. By comparing the skeletal, dental, tongue patterns as well as hyoid bone position between patients treated with tongue crib in 6 months and without any treatment, they found that more retroclination of maxillary and mandibular incisors (decrease in ∠L1 to NB, L1 to NB mm, L1 to A-Pog, L1 to Facial plane, U1 to FH, U1 to SN, ∠U1 to NA) was seen in dental change of tongue crib group, which resulting more increase in overbite.

However, these dental cephalometric changes was not only significant in patients successfully treated with tongue crib, but also seen in those failure patients. They further compared the cephalometric difference between success and failure groups using tongue crib. Results showed some pre-treatment dental and skeletal measurements could distinguish whether a certain anterior open bite patient could be successfully treated by tongue crib. In those successfully treated patients, they had less negative OB, gonial angle, anterior facial height, facial length on Y-axis. They also had higher IMPA and palatal plane angle than failure group. In words, if an open bite patient is checked with more obvious dolichofacial pattern, longer anterior facial height, and steeper palatal plane, this patient may be difficult to successfully treated by tongue crib. This indicates the tongue crib is more applicable to the anterior open bite caused by oral habits, instead of skeletal vertical growth pattern.

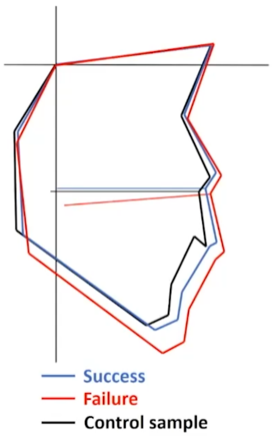
Dr. Jinbeom Kim illustrated the conclusion by a success patient and a failure patient.

Distinguishable cephalometric measurements between success and failure patients treated with tongue crib



- **Success group**

1. Negative OB ↓
2. IMPA ↑
3. Gonial angle (lower) ↓
4. Anterior facial height (Na-Me) ↓
5. Facial length on Y-Axis (Sella-Me) ↓
6. Palatal plane angle ↑



- **Failure group**

1. Negative OB ↑
2. IMPA ↓
3. Gonial angle (lower) ↑
4. Anterior facial height ↑
5. Facial length on Y-Axis (Sella-Me) ↑
6. Palatal plane angle ↓
7. Hy-Ba ↑
8. Hy to NSL ↑
9. Hy to SL ↑

03.Case summary of the success patient

An 8Y-2M girl complained of anterior open bite. Extraoral examination showed normal anterior facial height and straight profile. Intraoral images showed mixed dentition with Class I relationships, anterior open bite. Cephalometric analysis showed that she had a skeletal Class I (ANB = 2.62°) , averaged mandibular angle (FMA=28.74°), basically normal anterior facial height (113.63 mm) and facial height ratio (62.11%). Mild labioversion of upper incisors (U1-SN=110.81°)and lower incisors (IMPA=98.96°) could be seen. The pattern of cephalometric analysis of this patient is similar to the pattern of success group.

By using fixed tongue crib appliance for 7 months, the anterior open bite has been fully closed. The post-treatment cephalometric analysis showed the decrease of upper and lower incisors and the increase of overbite. The vertical growth pattern did not significantly change.

Pre-treatment record of success patient

Pre-Treatment

Variables	Norm	Pre-Tx
Point A to N-perp (mm)	0.4	-1.97
Pog to N-Perp (mm)	-1.8	-5.82
SNA (°)	80.07	79.29
SNB (°)	76.73	76.67
ANB (°)	3.27	2.62
Mn body/Ant. Cranial base	0.96	0.95
SN-MP angle (°)	32.46	36.47
Post facial height (mm)	70.12	70.58
Ant facial height (mm)	109.91	113.63
Facial height ratio	63.79	62.11
FMA (°)	31.71	28.74
FMIA (°)	57.33	52.3
IMPA (°)	90.84	98.96
L1 to A-Pog (mm)	4.55	6.32
U1 to FH (°)	109.02	120.07
U1 to SN (°)	103.02	110.81
Interincisal angle (°)	126.47	110.23
ODI	70	66.99
APDI	85.74	84.64
Upper lip (E-line)	7.58	-0.25
Lowe lip (E-line)	4.96	0.11

Post-treatment record of success patient

Variables	Norm	Pre-Tx	Post-Tx
Point A to N-perp (mm)	0.4	-1.97	-0.44
Pog to N-Perp (mm)	-1.8	-5.82	-10.06
SNA (°)	80.22	79.29	81.51
SNB (°)	76.18	76.67	77.8
ANB (°)	4.08	2.62	3.71
Mn body/Ant. Cranial base	1	0.95	1.01
SN-MP angle (°)	32.46	36.47	38.83
Post facial height (mm)	73.12	70.58	73.52
Ant facial height (mm)	113.88	113.63	117.2
Facial height ratio	64.20	62.11	62.72
FMA (°)	31.71	28.74	30.8
FMIA (°)	57.33	52.3	65.24
IMPA (°)	90.84	98.96	86.68
L1 to A-Pog (mm)	4.55	6.32	-0.15
U1 to FH (°)	109.02	120.07	110.4
U1 to SN (°)	103.02	110.81	102.37
Interincisal angle (°)	126.47	110.23	131.5
ODI	70	66.99	68.69
APDI	85.74	84.64	80.47
Upper lip (E-line)	7.58	-0.25	0.85
Lowe lip (E-line)	4.96	0.11	0.63

04.Case summary of the failure patient

A 10Y-9M boy complained of anterior open bite. Extraoral examination showed long anterior facial height and straight profile. Intraoral images showed mixed dentition with Class II tendency, moderate anterior open bite. Cephalometric analysis showed that she had a skeletal Class II tendency (ANB = 4.81°) , hyperdivergent mandibular angle (FMA=38.05°), larger anterior facial height (134.81 mm) and posteior facial height ratio (82.07 mm). Labioversion of upper incisors (U1-SN=117.08°)and upright lower incisors (IMPA=90.2°) could be seen. The pattern of cephalometric analysis of this patient is similar to the pattern of failure group.

By using fixed tongue crib appliance for 9 months, there was no significant change in the anterior open bite. The post-treatment cephalometric analysis showed a significant increase in anterior facial height (134.81 to 143.68 mm) and decrease in the facial height ratio (61.88 to 59.54 %), even though a mild retroclination of upper and lower incisors could be observed. This indicated the anterior open bite could not been treated by tongue crib as the facial height became longer.

Pre-treatment record of failure patient

Pre-Treatment

Variables	Norm	Pre-Tx
Point A to N-perp (mm)	1.1	3.22
Pog to N-Perp (mm)	-0.3	-4.94
SNA (°)	82.08	83.77
SNB (°)	77.71	78.96
ANB (°)	4.37	4.81
Mn body/Ant. Cranial base	1.06	1.05
SN-MP angle (°)	33.7	46.27
Post facial height (mm)	75.84	82.07
Ant facial height (mm)	118.17	134.81
Facial height ratio	64.12	61.88
FMA (°)	30.08	38.05
FMIA (°)	55	58.75
IMPA (°)	94.93	90.2
L1 to A-Pog (mm)	4.68	4.11
U1 to FH (°)	109.63	125.3
U1 to SN (°)	103.08	117.08
Interincisal angle (°)	126.83	110.45
ODI	70.32	63.64
APDI	85.98	72.73
Upper lip (E-line)	1.76	3.42
Lowe lip (E-line)	2.63	3.89

Post-treatment record of failure patient

Post-Treatment

Variables	Norm	Pre-Tx	Post-Tx
Point A to N-perp (mm)	1.1	3.22	1.35
Pog to N-Perp (mm)	-0.3	-4.94	-8.65
SNA (°)	81.77	84.37	84.38
SNB (°)	80.42	78.96	78.75
ANB (°)	2.05	5.41	5.63
Mn body/Ant. Cranial base	1.08	1.05	1.08
SN-MP angle (°)	32	46.27	47.95
Post facial height (mm)	90.48	82.07	85.55
Ant facial height (mm)	136.42	134.81	143.68
Facial height ratio	66.00	61.88	59.54
FMA (°)	26.78	38.05	32.18
FMIA (°)	63.25	58.75	63.48
IMPA (°)	90.2	90.2	84.34
L1 to A-Pog (mm)	4.68	4.11	3.65
U1 to FH (°)	116.52	125.3	121.49
U1 to SN (°)	109.31	117.08	114.73
Interincisal angle (°)	126.19	110.45	117.98
ODI	71.1	63.64	58.69
APDI	85.98	72.73	77.25
Upper lip (E-line)	0	3.42	1.48
Lowe lip (E-line)	0	3.89	2.26

05.Indication and contraindication of tongue crib

The orthodontic treatment of anterior open bite should be based on the evaluation of dental, skeletal, soft tissue and growth pattern of the patient before treatment. Cephalometric analysis on certain measurements can help make a clear diagnosis on etiology of anterior open bite, so as to determine whether it is suitable for the application of tongue crib appliance. The indications of tongue crib for anterior open bite include tongue thrust habit is the primary factor of open bite, favorable and average vertical growth pattern, and open bite without other predisposing factors such as enlarged adenoid, tonsil hypertrophy. The contraindications of tongue crib include: tongue thrust habit is a secondary result from the functional adaptation to the open bite, vertical skeletal pattern showing larger anterior facial height and lower gonial angle, lower palatal plane angle as anterior slope of maxilla, and with other predisposing factors such as enlarged adenoid, tonsil hypertrophy.

There is a lot of evidence that tongue crib appliance can achieve a consistent dental effect in the treatment of anterior open bite, that is, the retroclination of upper and lower anterior teeth. As the orthodontists choose the proper indication for anterior open bite, the application of tongue crib can achieve good results. Compared with the removable tongue crib appliance, the use of fixed tongue crib can reduce the patient's compliance, which is conducive to the good treatment effect.

Case 4

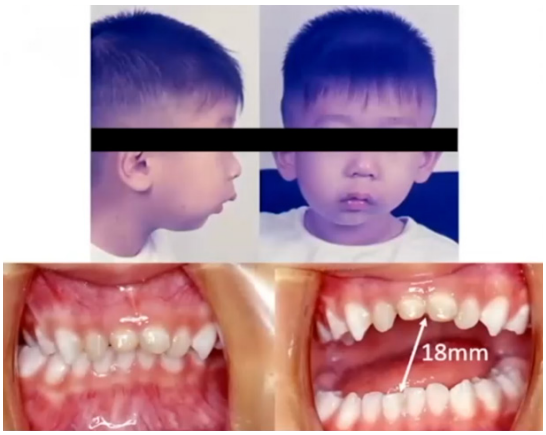
Staged management of recurrent unilateral TMJ ankylosis fron childhood to young adulthood

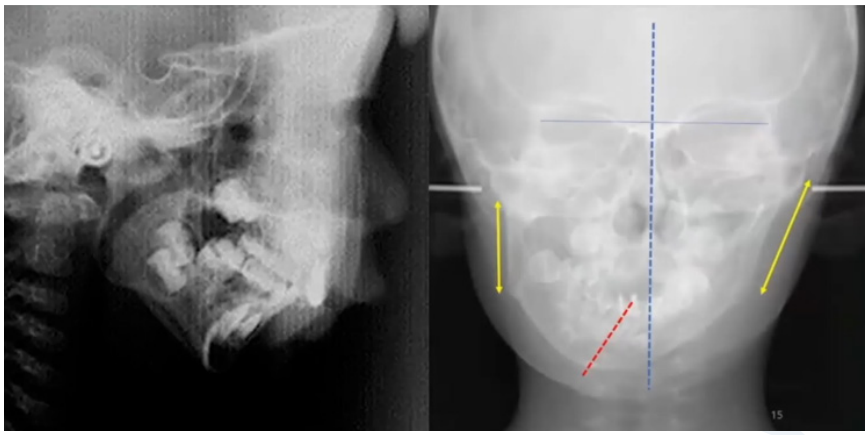
Speaker: Dr. Hyunseung Hong

01.Case summary

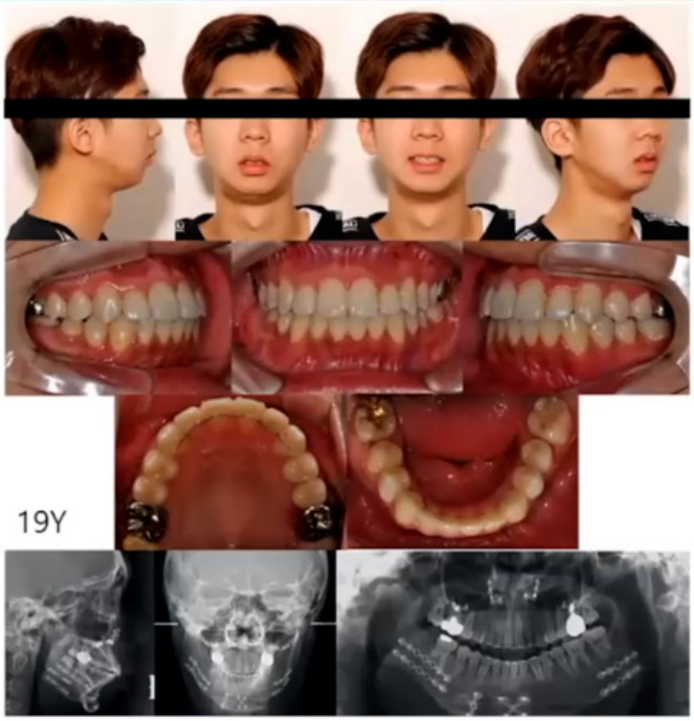
A 3-year-old boy complained of right TMJ ankylosis. His mouth opening was only 18 mm. Extraoral examination showed facial asymmetry with retrognathic chin shifting to the right. Intraoral examination showed primary dentition, right posterior crossbite and lower midline shifting to the right. Pre-treatment OPG illustrated disappearance of right TMJ space. Cephalometric showed retruding mandible and the backward B point (SNB=66.3°), high mandibular angle (SN-GoMe=44.6°). Posterior-anterior image showed asymmetric contour of mandibular ramus, evident maxillary occlusal plan canting and chin point deviation.

Pretreatment record of the unilateral TMJ ankylosis patient





Posttreatment record of the unilateral TMJ ankylosis patient



MMO: 29mm

Measurement	Phase 4 Presurgical orthodontic treatment	Debonding
Age	18 y, 4 mo	19 y, 0 mo
SNA (°)	89.8	82.9
SNB (°)	72.8	77.3
ANB (°)	17.0	5.6
SN-GoMe (°)	40.6	39.7
U1 to SN (°)	109.1	108.7
IMPA (°)	115.1	106.3
Interincisal angle (°)	95.1	105.2
Maxillary occlusal plane cant (°)†	3.0	0.5
Maxillary occlusal plane cant (mm)	2.5	0.5
Chin point deviation (mm)§	13.0	−1.0
Difference between the right and left sides		
Ramus height (ΔCo-Go, mm)	−38.0	−23.0
Body length (ΔGo-Me, mm)	−12.0	−14.0

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02.Problem list and diagnosis

Skeletal:

- Skeletal Class II, retrognathic mandible
- Hyperdivergent pattern
- TMJ ankylosis (right)
- Facial asymmetry (right)

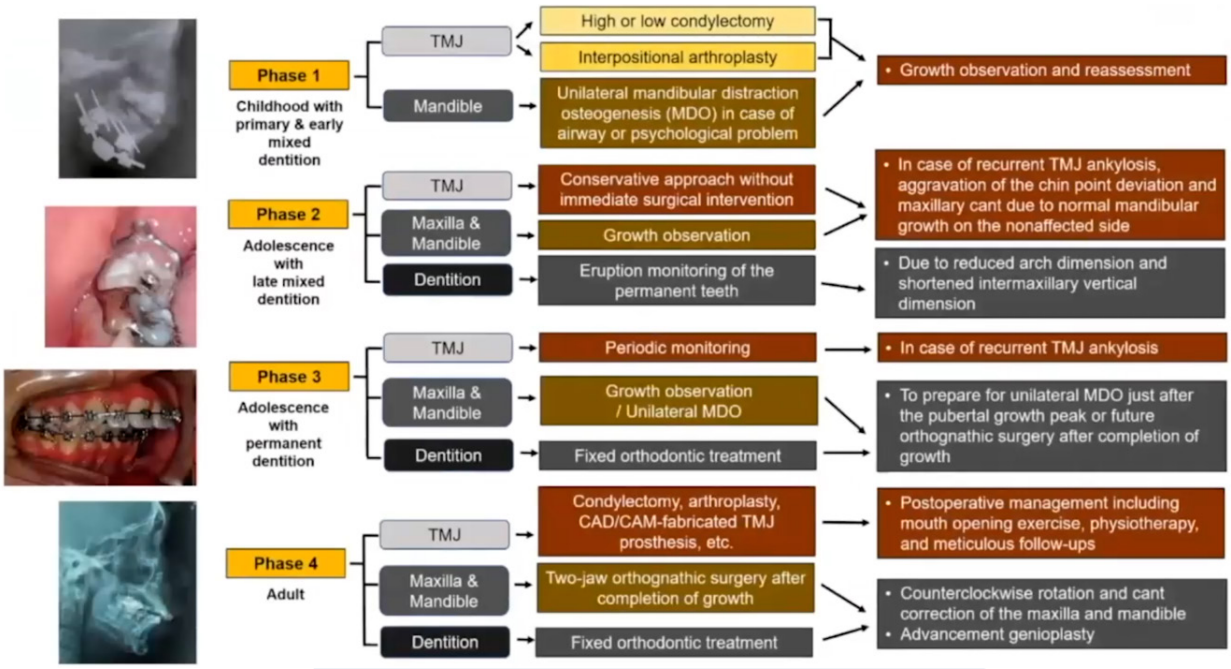
Dental:

- Class II occlusal relationship
- Occlusal plane canting
- Mouth opening limitation

03.Treatment plan and process

The four phases staged treatment plan are shown as the diagram below:

Staged treatment objectives and procedures for unilateral recurrent TMJ ankylosis



According to the phase 1 treatment plan, the purpose of therapy at this stage includes reconstruction of TMJ function and correction of mandibular asymmetry. The surgeon performed unilateral condylectomy and interpositional arthroplasty and unilateral mandibular distraction osteogenisis (MDO), simultaneously. As the ankylosed joint was released, the mouth opening increased to 34 mm, which was sufficient for the occlusal view intraoral image taking of the maxillary and mandibular dentition. As MDO progressed, the improvement of right molar relationship could be seen. The scissor bite of the left posterior teeth was also corrected. The mandibular advancement was achieved after distraction osteogenesis showing 5° increase in the SNB angle. The deviation of chin and the asymmetry of mandibular ramus was also corrected. A side effect of MDO was that the orientation of the unerupted second molar follicle was rotated.

In the phase 2 period, the permanent teeth started to erupt and replace. The group mainly observed the growth of the both jaws and take X-rays if necessary to ensure the normal eruption and replacement of the permanent teeth. The affected right TMJ ankylosis was re-ankylosed: The amount of mouth opening remained stable at the first 3 years after surgery, but relapsed again at the fourth year after phase 1 surgery. Although the right TMJ ankylosis recurred, the patient however refused immediate surgery at this stage.

In the third stage, after all the permanent teeth had been replaced, fixed orthodontic treatment was performed to align the teeth and prepare for future orthognathic surgery. If the deviation and mandibular asymmetry are too severe at this stage, MDO can be done again to increase the mandibular bone mass for future orthognathic surgery. In this phase, all four second molars were extracted due to severe tooth decay or impaction. Oral hygiene is difficult to maintain and proper dental treatment is difficult to perform due to limited mouth opening.

As the growth and development was done, the phase 4 treatment objective is to resolve all existing problems. Ankylosis recurrence of TMJ was corrected by arthroplasty, along with intensive physical therapy to prevent recurrence again. Afterwards, two-jaw orthognathic surgery with advancement genioplasty was performed by counterclockwise rotation and cant correction of the maxilla and mandible. The post-operative orthodontic treatment established a good and stable occlusal relationship. The patient's mouth opening increased to 29 mm. The ANB Angle decreased from 17° to 5°. The occlusal and skeletal relationship between the upper and lower jaws was significantly improved before surgery and after treatment, and the occlusal plane canting was corrected.Class I relationship was also established on bilateral molars and canines after treatment. The upper and lower teeth were well aligned. The occlusal relationship remained stable for 3 years and 7 months after treatment.

Sequential changes of frontal and profile of the patient

05.Discussion and learning

[1] Examination and diagnosis of unilateral TMJ ankylosis

Temporomandibular joint ankylosis is defined as fibrous or bony fusion between the mandibular condyle and thearticular fossa. The primary cause of TMJ ankylosis is the trauma of joint (31%-98%), other causes include local orsystemic infections (10%-49%), systemic diseases and congenital ankylosis. The prevalence of unilateral ankylosis is around 0.46/1000. Female predilection is also a feature of this disease.

Unilateral ankylosis is different from bilateral ankylosis as only one side is involved, that mandible in the ankylosis side cannot grow but the contralateral healthy joint can grow. This leads to the asymmetric mandible growth with the chin inclined to the affected side. Problems with unilateral TMJ ankylosis are compromised jaw function, asymmetric growth and dento-alveolar problems. Some patients have chewing, swallowing and speech dysfunction, while tooth eruption issues are also very common. Most of patients have poor oral hygiene due to the limited mouth-opening. The mandible retraction is also very common in these patients. The joint space of the ankylosis side disappears, the height of both mandibular ramus was asymmetric. The growth of the maxilla is also skewed by the asymmetry of the lower jaw. The consequent skeletal growth change can lead to facial asymmetry, menton deviation and occlusal plane canting. In terms of dental issues, arch asymmetry, unilateral posterior tooth scissor bite or crossbite, anterior open bite or deep overjet, and abnormal development and tooth eruption are usually involved. Severe mandible retraction can also cause airway obstruction.

[2] Treatment consideration of unilateral TMJ ankylosis

The current gold standard for the treatment of unilateral TMJ ankylosis is interpositional arthroplasty, which is a surgical method separating the fused joint and interposing with a graft material, such as muscle-fascia or synthetic material. Other surgical procedures include gap arthroplasty, which is creating a gap by arthroplasty without grafting, and costochondral grafting, which is grafting an autogenous rib with growth capability. According to the degree of asymmetry, distraction osteogenesis can be used in addition to 2-jaw orthognathic surgery to correct skeletal discrepancies and asymmetries. While the aforementioned joint surgeries can help restore the joint function hindered by TMJ ankylosis, the last two surgeries can treat skeletal and facial deformities caused by joint ankylosis.

The proper treatment timing is as soon as the patient is diagnosed, because as TMJ treatment is delayed the asymmetry will worsen. Also, the patient may be suffering from difficulty in speaking, swallowing, eating and chewing, in some cases even breathing, all of which are conditioned that must be addressed and treated as early as possible in order to restore the normal growth and function.

TMJ ankylosis treatment is difficult because of its high incidence of relapse and the difficulty in predicting relapse. The reason for the relapse of TMJ ankylosis may be related to the long-term disuse of the joint and the direct bony contact between the condyle and the fossa. According to the literatures, complete ankylosis removal, aggressive physiotherapy and making enough gap space or interposing graft material to physically separate the joint parts are the key to preventing ankylosis relapse. Treatment of TMJ ankylosis can be a long journey from childhood to adulthood. Perhaps it will be almost impossible to treat the patient with a single treatment plan that accounts for all the possible events and problems in different stages. Therefore, when treating a TMJ ankylosis patient in growing patient, it might be advisable to analyze the patient in different stages and come up with a multi-stages treatment plan to deal with specific problems step by step. At each stage of treatment, orthodontist should give the patient multiple treatment options, and constantly communicate with the patient and to understand the patient's needs.