IOF International Orthodontics Foundation Clinical Showcase

LEARNING & REFLECTION

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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.

Showcase stop 11 Esthetics In Orthodontics

Under the moderation of Dr. Chung How Kau, professor and director of the Department of Orthodontics at the University of Alabama at Birmingham, this IOF seminar invited two young scholars, Dr. Jue Wang and Dr. Eva Veiszenbacker, as speakers who have studied at the University of Alabama. Dr. Kau also invited Professor Peter Borbely, the President of the Hungarian Orthodontic Society, and Professor Anmol S. Kalha, the Emeritus Professor of the Institute of Oral Sciences, to moderate the discussion after the presentations.

Topic 1: Smile attractiveness evaluation of patients selected for U.S.-based board certification examination

Speaker: Dr. Jue Wang

Dr. Jue Wang, assistant professor of pediatric dentistry at Children's Hospital of Cincinnati, introduced a clinical study she conducted at the University of Alabama with the theme of " Smile attractiveness evaluation of patients selected for U.S.-based board certification examination." This study evaluated the smile attractiveness of 68 patients who passed the clinical assessment of the American Board of Orthodontics (ABO) and analyzed associated factors that might affect the scoring of smile attractiveness.

Objectives:

To assess the attractiveness of smiles in ABO-certified cases and determine whether different raters perceive smile attractiveness differently, as well as the influence of gums, teeth, lips, and other factors on the smile.

Inclusion and exclusion criteria:

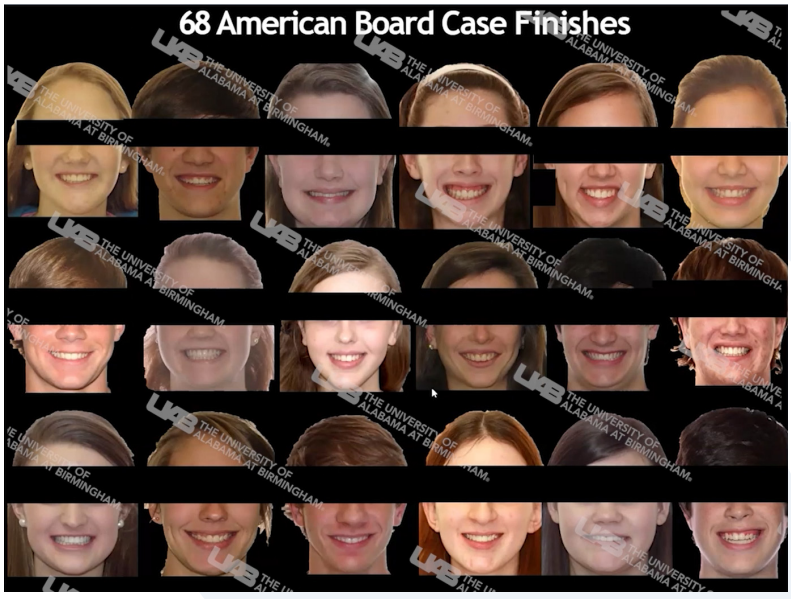
The frontal smiling images from a total of 68 patients after treatment were collected from the clinical cases that passed the ABO certification examination. Inclusion criteria: ① Patients with complete post-treatment records. ② Cases from ABO examination of 2013-2018 were considered to have been successfully treated. ③ No restrictions on age and ethnics of patients. Exclusion criteria: ① Poor quality of smiling images. ② Images that do not meet ABO standards. ③ Images that cannot be well adjusted and calibrated.

Methods:

A total of 81 raters were recruited, including orthodontists, periodontists, surgeons, and prosthodontists. The raters were asked to answer two questions for assessing each smile image. ① Rate the smile attractiveness from 1 to 10. ② What components make the smile less attractive in your opinion? The raters could choose from lips, gums, teeth, or none of the above.

Statistical analysis:

①The mean value and standard deviation of the smile attractiveness score were calculated. ②The correlations between age, professional experience, gender, and other variables of the rater and the smile attractiveness score were analyzed using multilevel mixed linear regression analysis. ③The ROC curve was plotted to determine the correlation between smile attractiveness and the perfect smile.



Smiling images of a total of 68 ABO certified cases

Two questions the raters need to accomplish to assess smile attractiveness

Results:

Attractiveness score of smiling images ranged from 3.11±1.47 (least attractive smile) to 7.59±1.45 (most attractive smile). The average score was 5.30±1.10. Nearly 94% of the score was regarded influenced by the teeth. 50% was influenced by the gums and 12% by the lips. When the lips factor was considered as the main factor, the score least affected by the lips was 7.58±1.63, and the score most affected by the lips was 5.08±1.88.

Lips morphology that least and most affected smile attractiveness

When the gums were considered as the main factor determining smile, the score least affected by the gums was 8.12±1.42, and the score most affected by the gums was 4.69±1.96.

Gums morphology that least and most affected smile attractiveness

When the teeth were considered as the main factor determining smile, the score least affected by the gums was 8.46±1.59, and the score most affected by the gums was 3.42±1.83.

Teeth morphology that least and most affected smile attractiveness

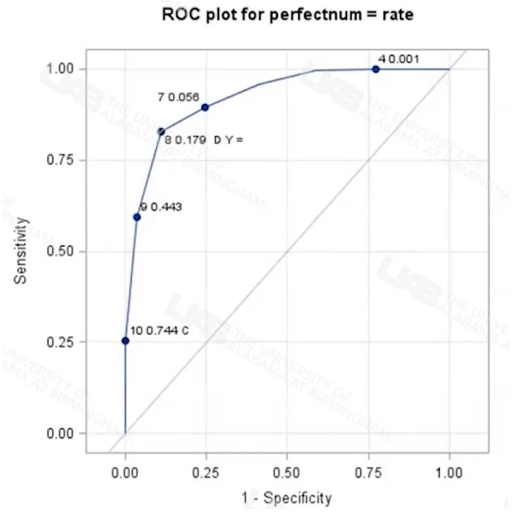
Results Predictors of Attractiveness Identified by Multilevel Mixed Linear Regression Model

Parameter	Changes in Rating (95% CI)	Pr > |t|
Problems with lips	-1.47 (-1.56, -1.37)	<.0001
Problems with gums	-1.82 (-1.92, -1.73)	<.0001
Problems with teeth	-1.56 (-1.66, -1.47)	<.0001
Periodontist vs. Orthodontist	-0.33 (-0.87, 0.20)	0,2252
Plastic Surgeon vs. Orthodontist	-1.98 (-2.60, -1.37)	<.0001
Prosthodontist vs. Orthodontist	0.02 (-1.15, 1.19)	0,9721
Female vs. Male	0.16 (-0.34, 0.67)	0,5341

Results of multilevel mixed linear regression analysis

The results of multilevel mixed linear regression analysis showed that the inharmonious lips, gums, and teeth would reduce the smile attractiveness to certain degrees. Plastic surgeons were especially strict in assessing smile attractiveness, while the scores between orthodontists and prosthodontists, as well as between orthodontists and periodontists, were similar and with no statistical difference. In addition, gender was not a predictor of smile attractiveness.

ROC analysis between smile attractiveness scores and the perfect smile showed that when the smile attractiveness score was above 7.4, there was an optimal combination of sensitivity and specificity. Looking back at all the 68 images, only 2 of 68 had a score higher than 7.4, which was about only 2.94%.



ROC (Receiving operating curve) analysis

Research conclusion:

According to the ROC analysis, when the smile attractiveness score was above 7.4, only two cases among 68 certified cases were regarded as the perfect smile. Plastic surgeons were more stringent in assessing smile than orthodontists, while the prosthodontists and periodontists had similar scoring with orthodontists. Gender was not a predictor of smile attractiveness. The morphology of gums, teeth, and lips during smile were more closely related to the smile attractiveness.

Discussion

An ideal occlusal relationship at the end of orthodontic treatment is not always along with a perfect smile. Orthodontists should pay more attention to smile aesthetics in treatment planning. Tooth position and morphology was not the only factor that affects the attractiveness of smile. The harmony of soft tissues like gums and lips also play vital roles in determining whether a smile is attractive. Therefore, multidisciplinary treatment including orthognathic surgery, periodontology, and prosthodontics were required in certain cases to obtain a beautiful smile. Dr. Jue Wang's research raised a discussion in experts and made them think about whether it is worthwhile to revise the ABO scoring system and add objective quantification items to assess the smile after treatment, or using software to quantitively predict the smile as a part of treatment planning.

ABO assessment criteria have always been composed of dental model assessment and radiographic assessment. Model assessment involves alignment, adjacent marginal ridges, buccal and lingual inclination, occlusal relationships, occlusal contact, overjet and interproximal contact of teeth. Radiographic assessment includes root angulations. Many experts have also proposed whether it is necessary to introduce aesthetic evaluation indicators as part of the ABO assessment system, rather than only focusing on the final occlusion in dental model assessment.

Occlusion, function, stability, and aesthetics are important components and also the objectives of orthodontic treatment. Orthodontists should not only pursue one of them, but should maximize the improvement of patients' aesthetics after treatment on the basis of obtaining a good occlusion. Meanwhile, orthodontists also need to recognize the limitations of orthodontic treatment, as well as the boundaries of tooth movement, and provide patients with treatment goals that are consistent with their age and biological conditions. They should not only pursue aesthetics while ignoring the health of teeth and the function of occlusion. In addition, orthodontists should fully and consistently communicate with patients to ensure they can make the right decision on treatment goals.

Questions raised from Dr. Peter Borbely and Dr. Anmol S Kalha during the discussion section were listed below:

①Is there any way we can take smile factors into consideration when making orthodontic treatment plans?

② Is it necessary to modify the evaluation parameters in the ABO assessing system? Should we add parameters related to soft tissue or aesthetic?

③ Under what circumstances should patients be taught that it is equally important to pay attention to good occlusion?

④ Where is the limit of pursuing aesthetics? How to strike a balance between aesthetics and occlusion?

Topic 2: Management of smile esthetics in orthognathic surgery cases

Speaker: Dr. Eva Veiszenbacker

Dr. Eva Veiszenbacker, an orthodontist from Budapest, Hungary, then gave a case report presentation on the aesthetic considerations of two orthognathic surgery cases, with the topic "Management of smile esthetics in orthognathic surgery cases"

Case 1:

A 25-year-old female patient complained of an unattractive smile and crooked teeth.

Extraoral examination: concave profile, maxillary retraction, slightly protruding mandible, normal vertical facial proportions, excessive exposure of mandibular incisors when smiling, lower midline deviated 1mm to the left.

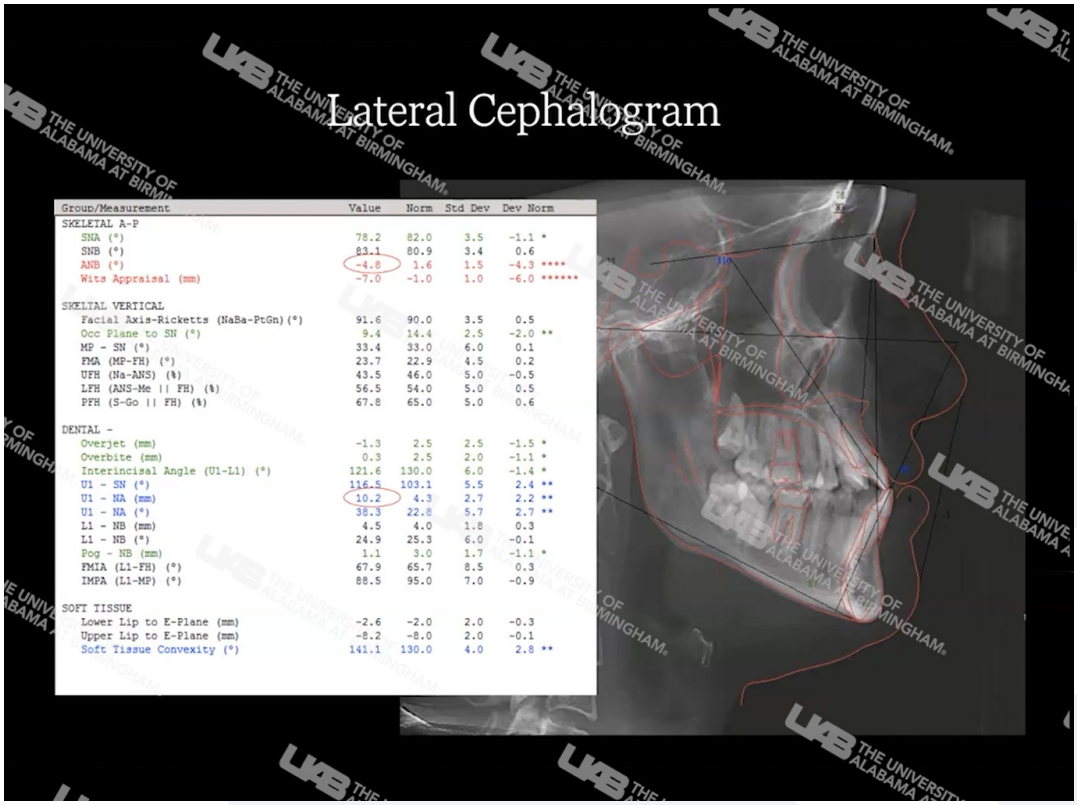
Intraoral examination: narrow upper dental arch, maxillary crowding 8 mm, neutral relationship of bilateral molars, class III relationship of right canine, crossbite on maxillary lateral incisor, no functional factors.

Initial extraoral and intraoral images

Radiographic examination: The initial OPG showed impacted third molars

Initial OPG

Diagnosis of cephalometrics: skeletal Class III, labial inclination of the upper incisors, slight lingual inclination of the lower incisors.



Initial lateral ceph

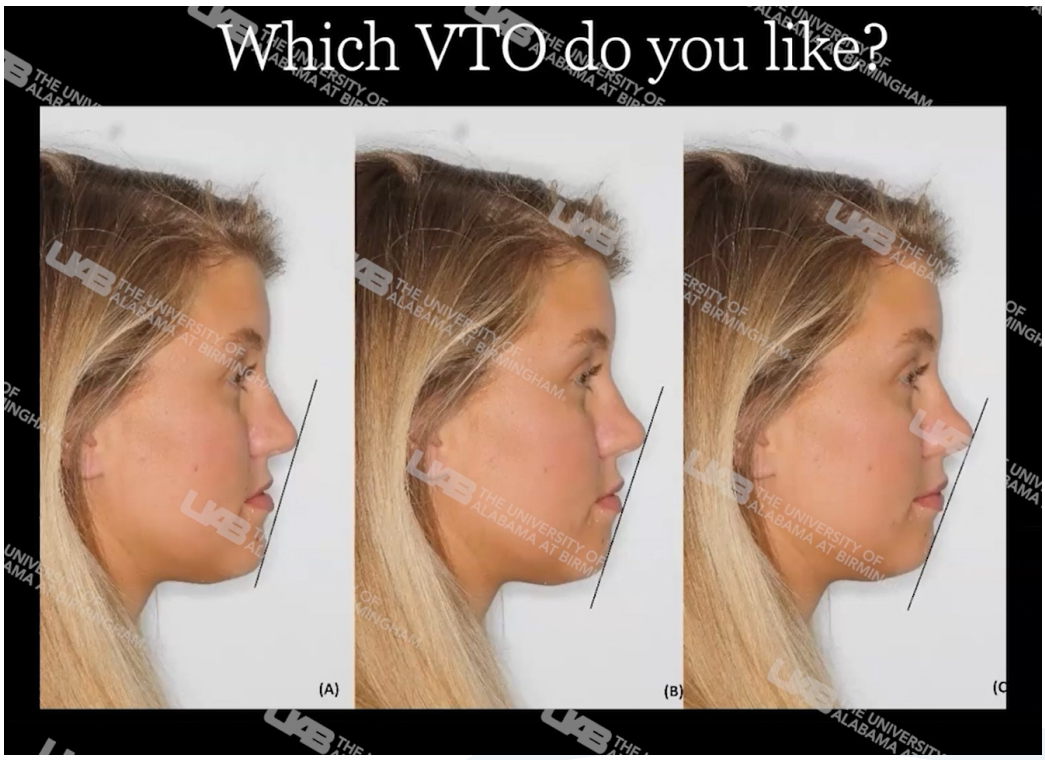
Treatment goals: Correct the compensatory inclination of incisors, match the upper and lower arch widths, rebuild normal jaw relationships and oral function, improve profile and smile aesthetics.

Treatment plan:

Option 1: Single jaw surgery: Extraction of maxillary first premolars + Lefort I osteotomy

Option 2: Two jaw surgery: Extraction of maxillary first premolars + Lefort I osteotomy + BSSRO

Bimaxillary surgery was recommended after VTO simulation and the patient accepted.



VTO analysis: (A) Initial lateral view, (B) single jaw surgery VTO simulation, (C) two jaw surgery VTO simulation

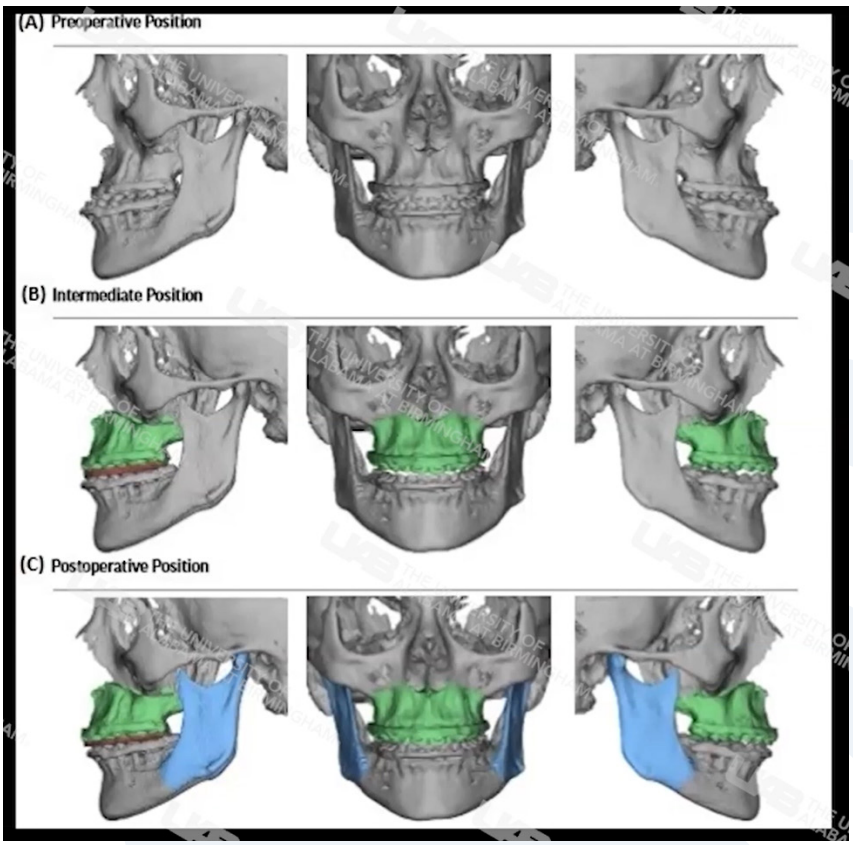
Treatment process:

In pre-surgical orthodontic treatment, maxillary space closure and anteirors decompensation was performed, which made concave profile worse. Orthognathic surgery design: The upper jaw was moved forward by 5 mm and lifted up by 1 mm to avoid excessive gingival exposure, while the lower jaw moved backwards by 3.3 mm and upward by 1.60 mm. Post-surgical orthodontics began 4 weeks after surgery, light elastics was used for minor adjustment to coordinate the upper and lower arches. It lasted 8 months for post-surgical orthodontics.

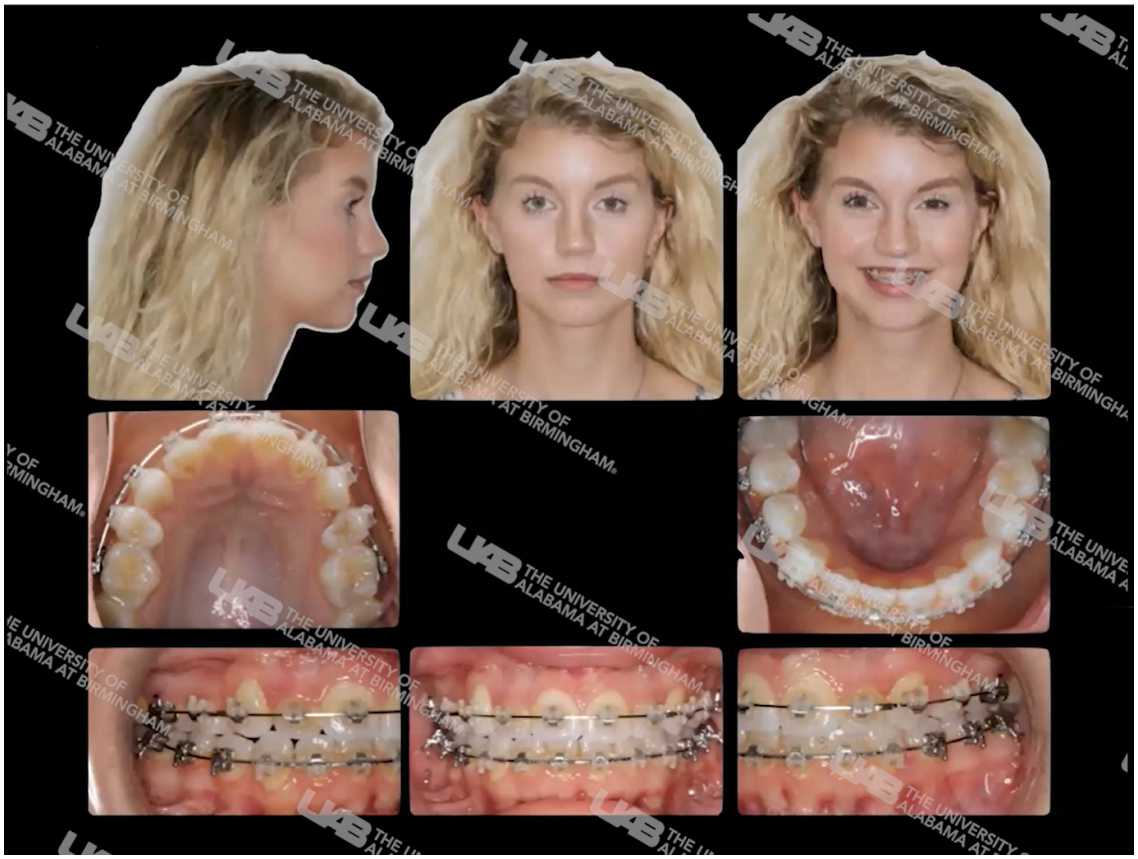
Treatment results:

Cephalometric superimposition showed that the upper incisors were upright and the lower anterior teeth were slightly labially inclined after treatment. The upper jaw moved forward with slight lifting, the lower jaw moved backward. Contour of lips and the concave profile were improved. An Essix removable retainer was applied for retention. Micro-aesthetic adjustments were made after orthodontic treatment by performing gingivectomy on the upper right lateral incisor to coordinate the gingival margin.

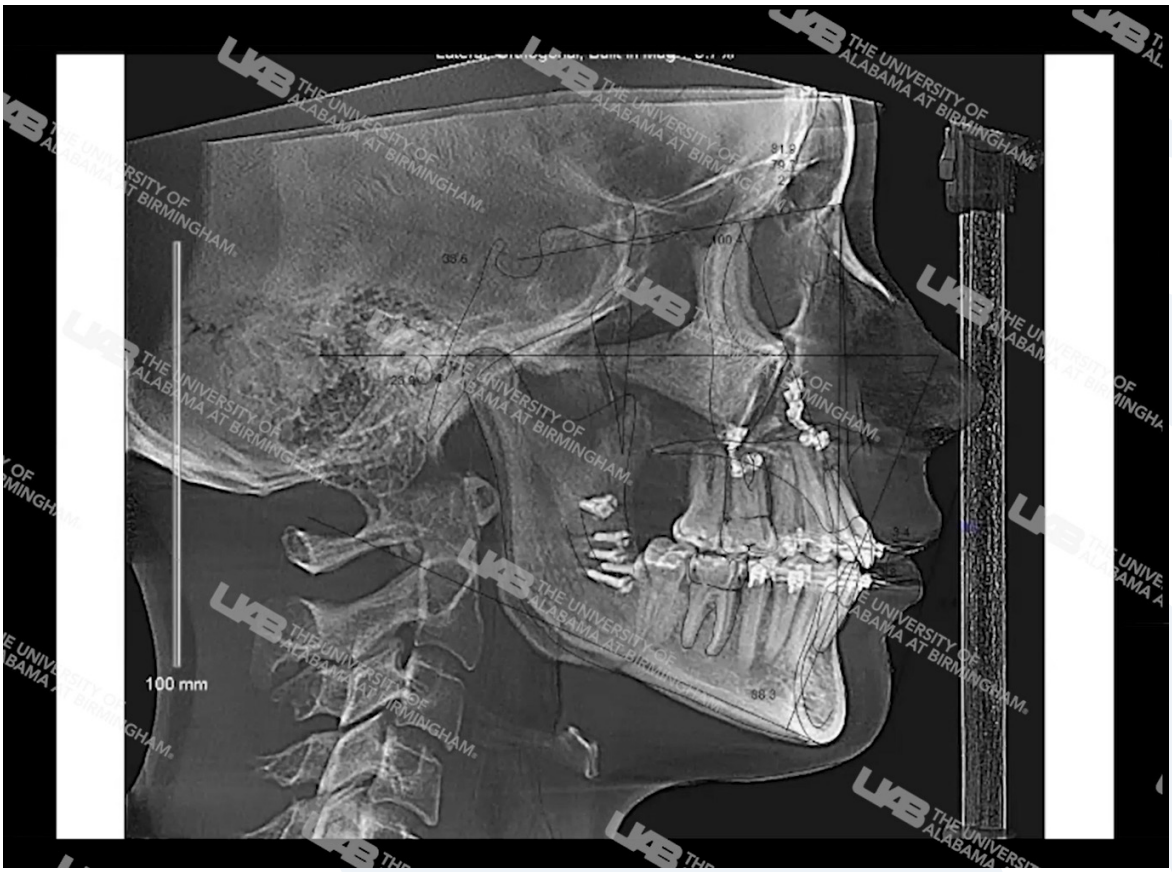
Pre-surgical extraoral and intraoral views



3D surgery simulation

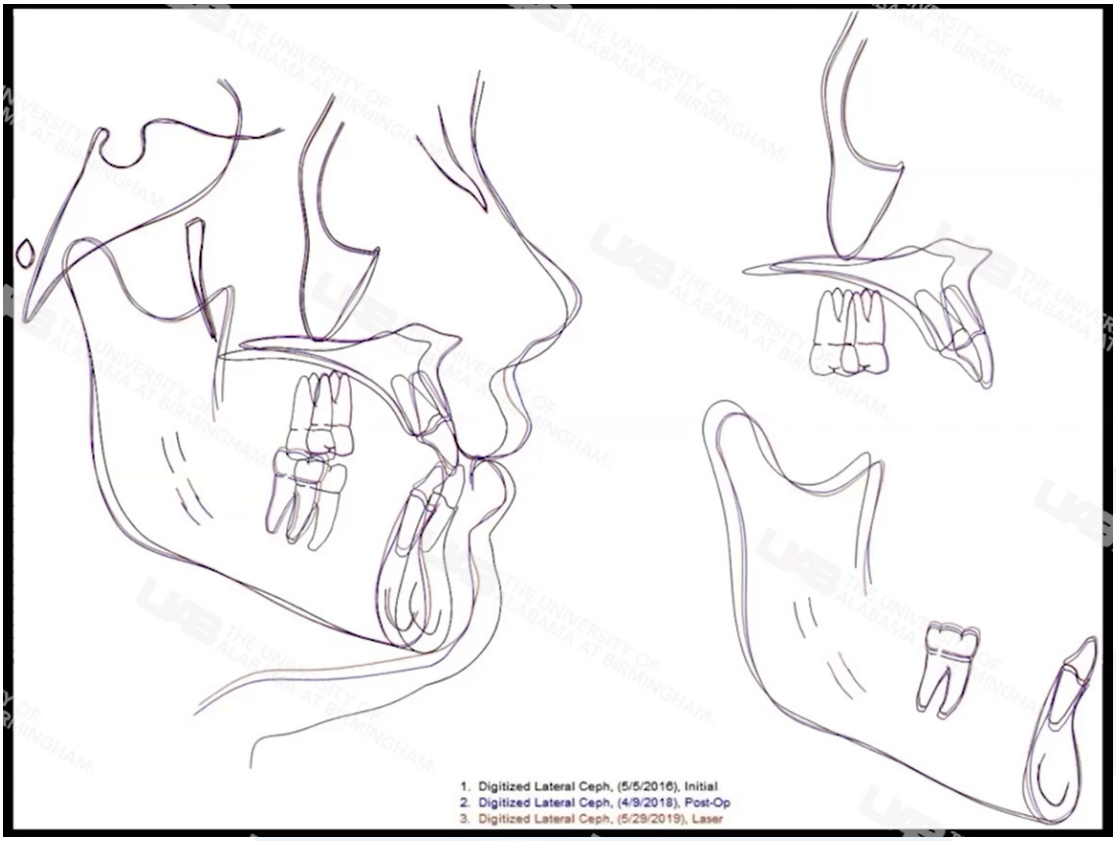


Extraoral and intraoral views before aplliances removal



Lateral ceph before appliances removal

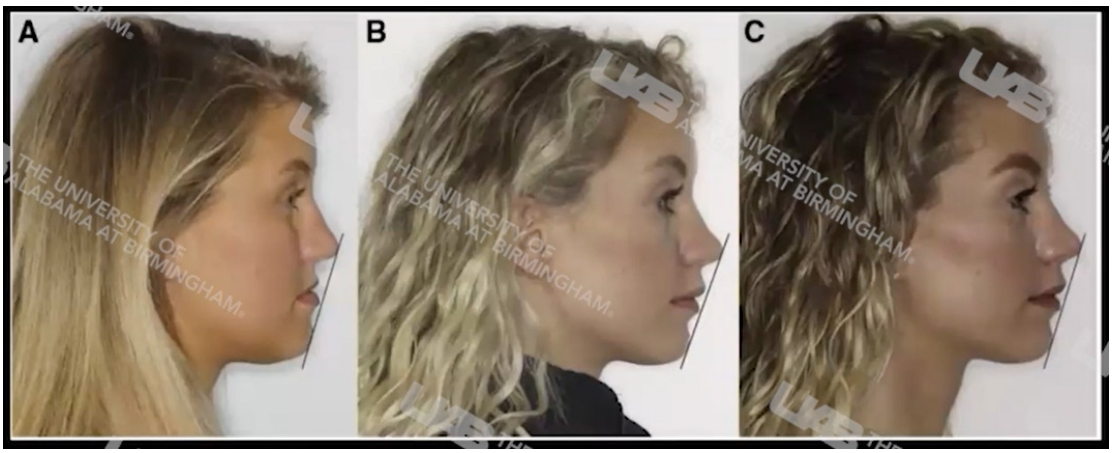
OPG before appliances removal



Superimposition before appliances removal

Final extraoral and intraoral views

After treatment : intraoral views top to bottom: after appliance removal, after gingivectomy, after healing of gingivectomy.



Profile comparison, left to right： Initial, final, and 6-months retention

Case 2

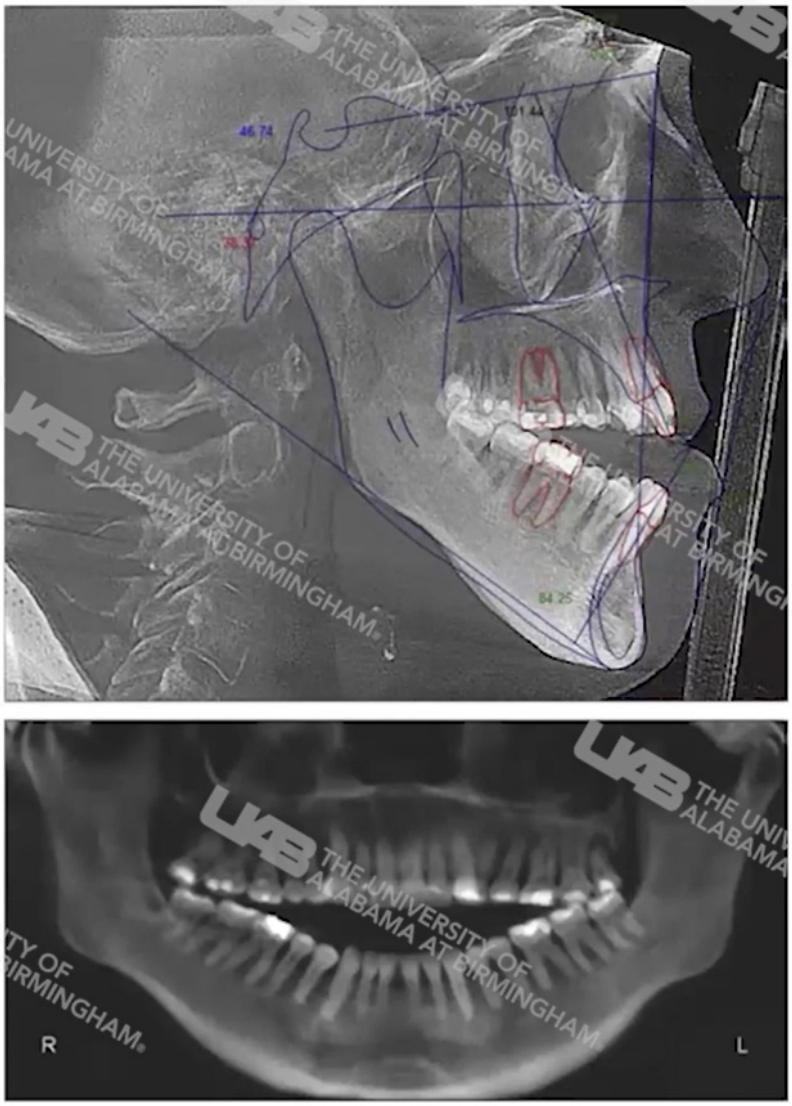
A 29-year-old female patient complained of inability to bite with her front teeth and unattractive smile.

Systemic history: tonsillectomy.

Extraoral examination: concave profile, protrusive lower lip, excessive lower facial height, and chin deviated to the left. No pain in the TMJ, the lower jaw shifted to the right in opening and closing.

Intraoral examination: 6-6 open bite, whole arch crossbite, severe crowding in the upper jaw, mild crowding in the lower jaw, mild gingivitis.

Initial extraoral and intraoral views



Initial lateral ceph and OPG

Initial Cephalometric analysis showed skeletal Class III (Wits -12.8 mm) and hyperdivergent in vertical growth pattern.

Treatment goals: Alignment, close the open bite, correct jaws discrepancy in three dimensions, improve the profile and facial height ratio.

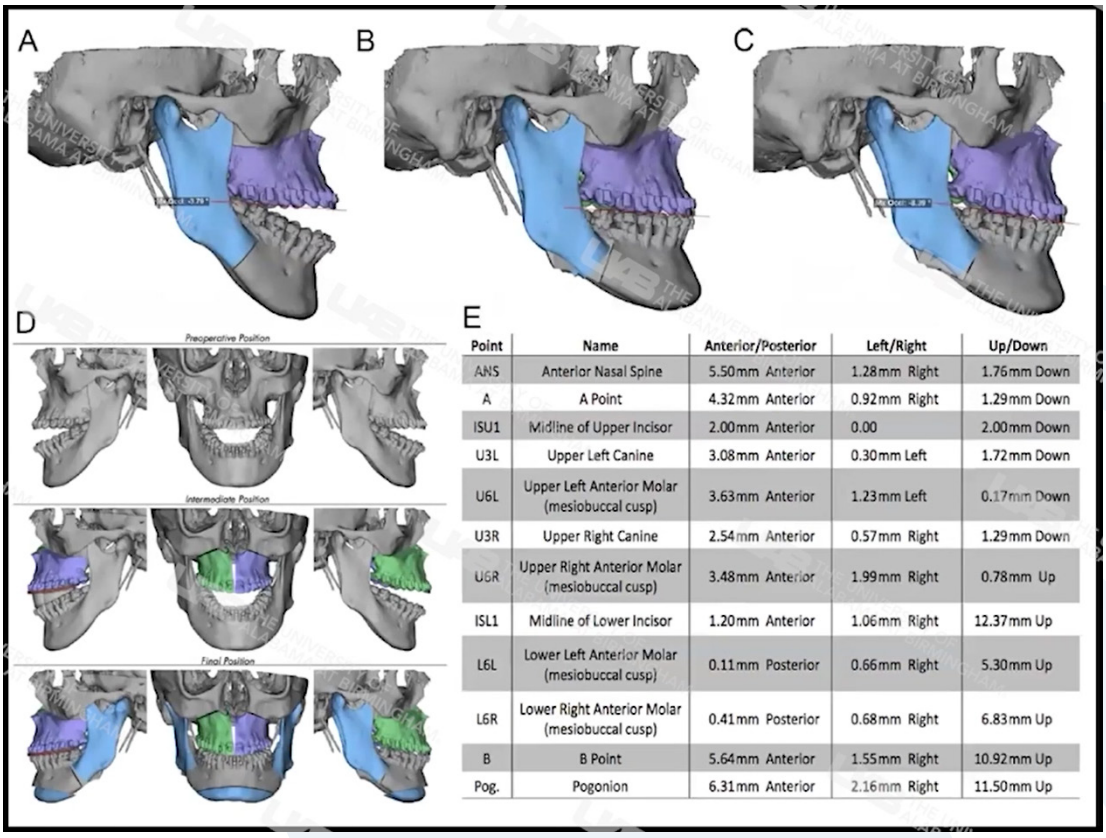
Treatment plan:

extraction of four wisdom teeth, two jaw surgery: maxillary Lefort I osteotomy and palatal segmentation + BSSRO + genioplasty.

Treatment process:

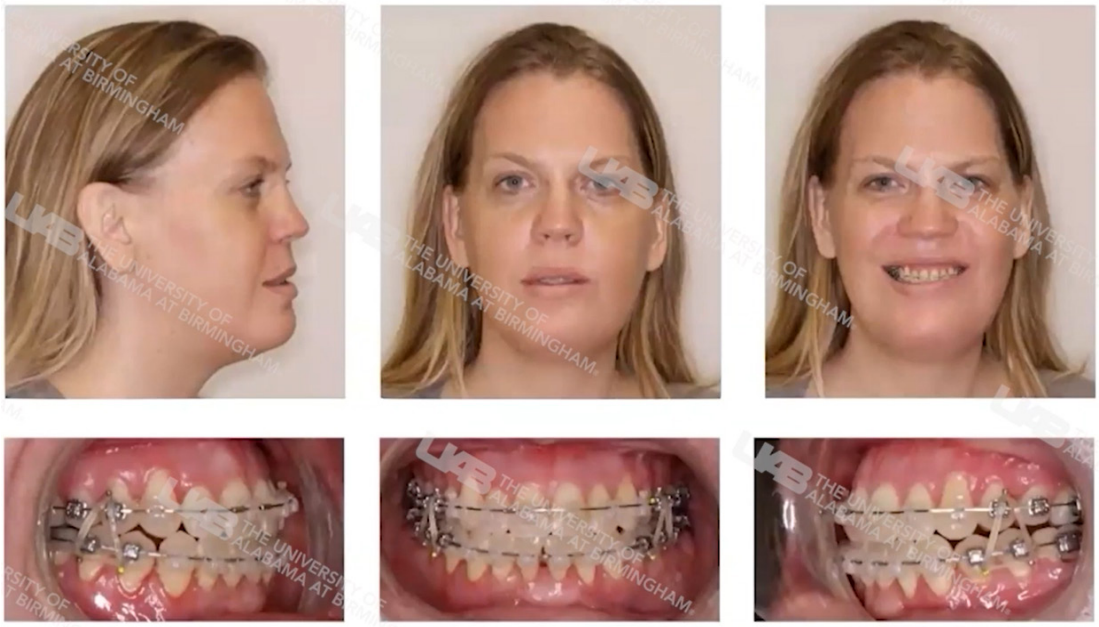
Alignment and leveling was performed in pre-surgical orthodontics and the open bite was maintained. Orthognathic surgery design: Lefort I osteotomy and palatal segmentation was performed in upper jaw for expansion by 3.5 mm, moving forward by 5 mm, clockwise rotation by posterior lifting and anterior downward. BSSRO was performed to counterclockwise rotate lower jaw. Genioplasty was performed with chin moving backward by 4 mm. Post-surgical orthodontics: Slight intermaxillary elastics started two weeks after surgery for final adjustment on TMA wires. The total treatment period was 19 months, and a removable retainer was used after treatment.

Pre-surgical extraoral and intraoral views

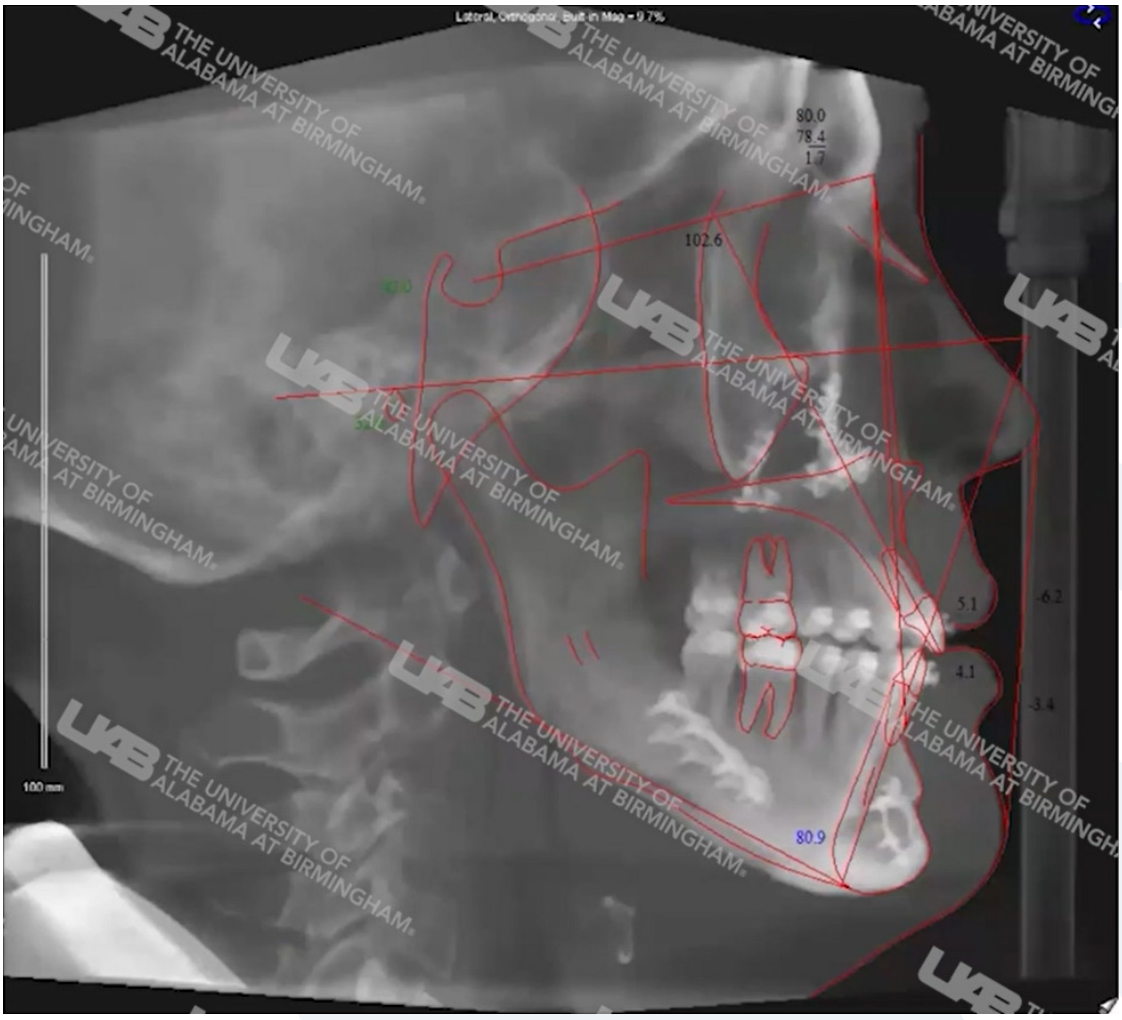


Point	Name	Anterior/Posterior	Left/Right	Up/Down
ANS	Anterior Nasal Spine	5.50mm Anterior	1.28mm Right	1.76mm Down
A	A Point	4.32mm Anterior	0.92mm Right	1.29mm Down
ISU1	Midline of Upper Incisor	2.00mm Anterior	0.00	2.00mm Down
U3L	Upper Left Canine	3.08mm Anterior	0.30mm Left	1.72mm Down
U6L	Upper Left Anterior Molar (mesiobuccal cusp)	3.63mm Anterior	1.23mm Left	0.17mm Down
U3R	Upper Right Canine	2.54mm Anterior	0.57mm Right	1.29mm Down
U6R	Upper Right Anterior Molar (mesiobuccal cusp)	3.48mm Anterior	1.99mm Right	0.78mm Up
ISL1	Midline of Lower Incisor	1.20mm Anterior	1.06mm Right	12.37mm Up
L6L	Lower Left Anterior Molar (mesiobuccal cusp)	0.11mm Posterior	0.66mm Right	5.30mm Up
L6R	Lower Right Anterior Molar (mesiobuccal cusp)	0.41mm Posterior	0.68mm Right	6.83mm Up
B	B Point	5.64mm Anterior	1.55mm Right	10.92mm Up
Pog.	Pogonion	6.31mm Anterior	2.16mm Right	11.50mm Up

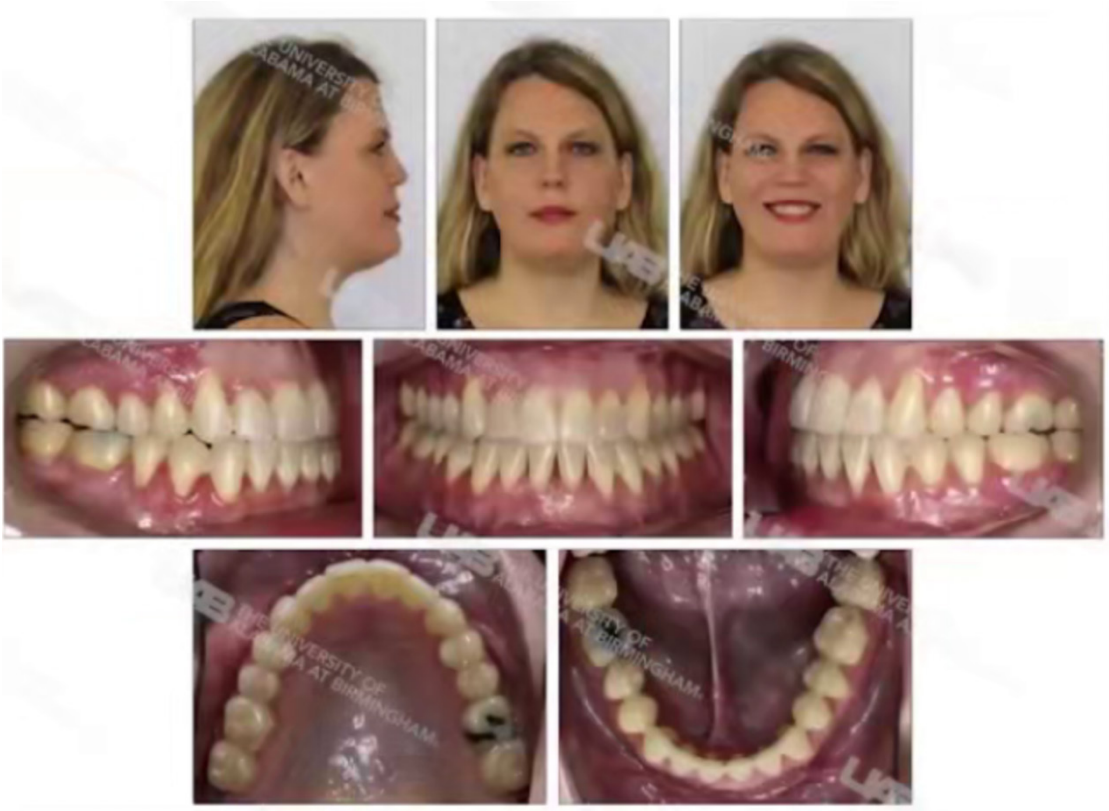
3D surgery simulation



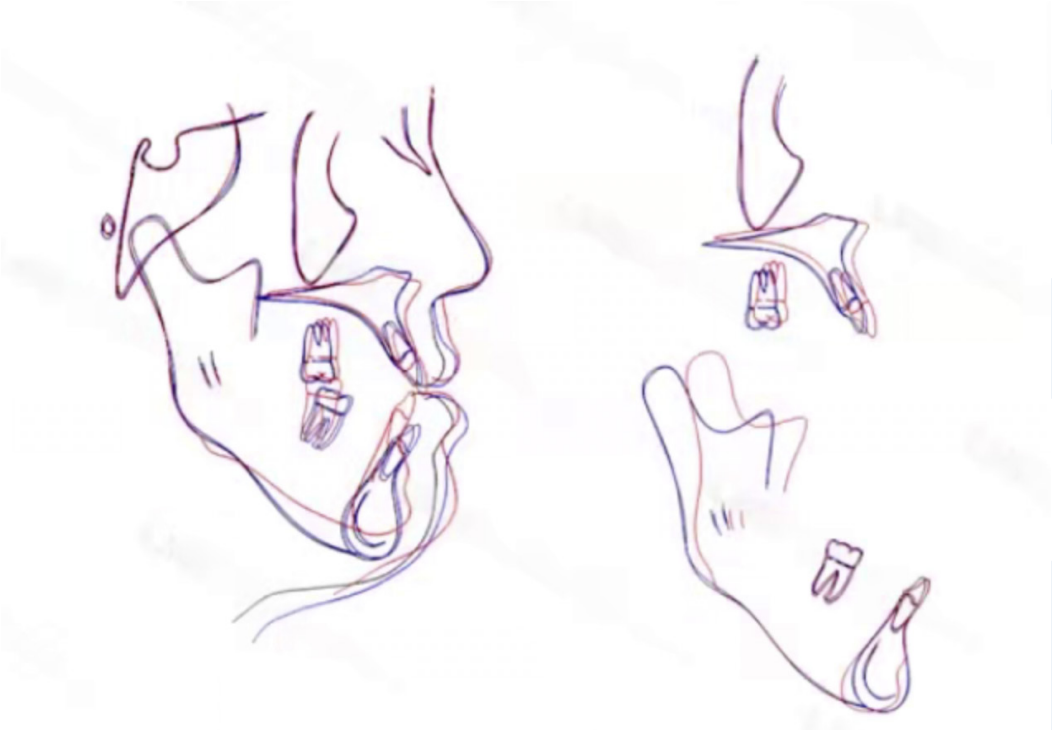
Post-surgical views



Lateral ceph before appliances removal



Final extraoral and intraoral views



Superimpostion before and after treatment

Slightly relapsed open bite and reduced overjet could be seen after 7 years retention

Discussion:

After sharing two cases, Dr. Eva Veiszenbacker compared traditional simulation planning (TSP) and virtual simulation planning (VSP) in discussion section. She pointed out that TSP required the collection of a large number of clinical records as well as the measurement of the patients' lateral ceph, photos and models. However, VSP combined with intraoral scanning and three-dimensional craniofacial digital models, which is able to accurately simulate the surgery process. The simulation results of VSP and TSP are basically the same if only the sagittal movement of segments were considered. However, for cases with transverse problems like facial asymmetry, VSP simulation can provide more specific simulation result of jaw movement. In addition, it takes much shorter time in model surgery in VSP and further models and occlusal plates 3D printing. VSP can also perform different treatment options and design different osteotomy lines in virtual software. With more accurate VSP, surgeons can predict issues that may occur during the surgery to reduce risks in the surgery, as well as reduce the surgery time.

The patient in case 2 had a mild relapse of crossbite and open bite after a follow-up 7-years retention. Dr. Eva further discussed the reasons might lead to relapse. Firstly, relapse in the post-orthognathic surgery can be divided into short-term and long-term relapse. Short-term relapse might be related to errors in the surgical plan or model surgery, inaccurate bone relocation during the surgery, or the wound healing process. Long-term relapse might derive from consistent muscle traction, functional matrix re-adaptation, condylar resorption, slight but continuous bone growth, and the post-surgical orthodontics. It should also be taken into account the individual differences of patients.

In the discussion section, Dr. Jue Wang also mentioned that for open bite surgery cases, orthodontists could design more tooth movement to reduce the extent of bone movement the if the surgery requires a large amount of counter-clockwise mandible rotation. Orthodontists can make posterior intrusion with TADs or perform extraction planning, which can reduce the amount of jaw movement to a certain extent. Dr. Anmol Kahla also mentioned that the muscle traction will consistently exist after surgery that leads to relapse. When a large range of jaw movement is performed, surgeons usually make myotomies to reduce post-surgical muscle tension.