O-1

Effect of Bifidobacterium and Lactobacillus on the stability and inflammation around mini-implants - animal model

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Purpose : The present study evaluated the effect of the topical administration of the Bifidobacterium animalis and the Lactobacillus johnsonii probiotic agents contained in fermented milk on the stability and inflammation around orthodontic mini-implants in rats following induction of gingival inflammation by ligatures.
Materials and methods : Two mini-implants were inserted in the palate of 20 animals (n=40), behind the upper incisors. Samples were divided into four groups according to the applied solution around miniscrews: BIF - Bifidobacterium animalis cncm I-2494 (n=10); LAC - Lactobacillus johnsonii (n=10); CLO - 0.12% chlorhexidine gluconate-based oral solution (n=10); and CON (control) - sterile saline solution (n=10). After 3 days of induction, the rats underwent analysis for stability (Periotest®) and inflammation signs for four days; subsequently, gingival fragments around the miniscrews were removed for RT-qPCR analysis of the expression of pro-inflammatory (IL-1β, IL-6, TNF-α) and anti-inflammatory (IL-10) cytokines.
Results : There was a significant reduction in IL-1β in the BIF while there was a significant increase in the LAC group compared to the CON group; both groups showed a significantly higher expression of IL-10 compared to CLO and CON groups (p
Conclusions : In the presence of inflammation, the administration of Bifidobacterium animalis may have a modulatory effect in the peri-implant region in rats by decreasing inflammation, maintaining miniscrew stability and improving clinical parameters while Lactobacillus johnsonii didn’t provide enough benefits and proved not to be a viable option in these parameters.

O-2

Is There a Correct Position of a Bracket?

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Introduction : I would like to start by asking you a question " Is there a correct position of a bracket?". Many of you would agree that the required core abilities upon an orthodontist are diagnostic capability and the ability to bond brackets to their correct position. Actually, most of the routine problems in daily orthodontic practice are closely related to the incorrect positioning of a bracket. It is not common that a case could be finished without the bracket repositioning and/or wire bending. There have been lots of tries to reduce or remove these tedious processes-bracket repositioning and wire bending.
Discussion : Attempts to accurately move the teeth to their planned position with minimal effort have been started with SWA, leading to indirect bonding, and now to custom brackets that are precisely tailored to individual patients. However, it is said that even if a highly precise custom-made bracket is bonded to the correct position, it cannot be possible to complete a case without repositioning of a bracket and wire bending. If so, now it is proper to look back at what has been wrong.
Conclusion : In the presentation, I will try to answer the question "Is there a correct position of a bracket?". And, I am confident that the answer will provide you a whole new clinical guideline.

O-3

COMPARISON OF BIOMECHANICAL AND SURFACE CHARACTERISTICS OF RETRIEVED ORTHODONTIC MINI SCREWS- AN IN VIVO STUDY

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Purpose : Mini-screws are valuable devices in orthodontic treatment as they allow effective and stable absolute anchorage. However, relocation of a mini-screw is sometimes required at various stages during treatment due to anatomical limitations or their interference with the path of tooth movement.
To analyze and compare the morphology and surface characteristics of 3 commercially available brands of mini-screws before and after clinical use, and check their viability for reinsertion during the relocation process.
Materials and methods : Mini-screws of three commercially available brands were evaluated for the sharpness of their threads and active tip, surface roughness and surface chemical composition using SEM-EDS before and after clinical use.
Results : The mean pre-insertion sharpness of threads did not differ significantly compared to mean post retrieval values in Group I, II and III. In Group II and Group III, the mean post-insertion α value is significantly higher compared to mean pre-insertion α value. The SEM images obtained post insertion revealed generalized loss of gloss and surface finish with a consequently dull appearance in all the groups, but most evident in Group I. EDS analysis post retrieval shows an increase in the amount of organic elements such as carbon and oxygen in groups II and III.
Conclusions : Mini-screw reuse within the same patient maybe possible provided proper recycling procedure has been followed and careful pilot drilling is done to overcome the decreased cutting ability of the tip due to deformation.

O-5

5 reasons why MARPE should be actively applicated

Mi young Lee
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Introduction : With the development of skeletal anchorage, there has been a remarkable development in orthodontics. Skeletal anchorage extended the improvement of the anterior-posterior relationship, and made the vertical movement very easy, which was very difficult to improve.
And horizontal expansion through the skeletal anchorage was very beneficial to both the clinician and the patient. In addition to the well-known information about horizontal expansion using MARPE, we will consider the reasons for using the appliance more actively.
Discussion : Five reasons.

1. For a Good finish
2. Easily guide in treatment progress
3 .For pre-surgical orthodontic treatment
4. Space recovery
5. Growth modification, ETC...

Conclusion : We present treatment examples for each reason and consider the results of appropriate horizontal expansion.
Treatment that proceeds without skeletal improvement of horizontal disharmony difficult to finish well. Especially in terms of the anterior overbite, the problem does not improve or relapse more easily.
In patients with asymmetry or anterior crossbite, the treatment process can be facilitated by first improving the appropriate horizontal relationship.
In contrast to the case where skeletal expansion is not preceded, if skeletal expansion is performed properly, the pre-surgical process becomes easier and the possibility of errors during surgery is reduced. The lack of space due to horizontal disharmony must be horizontally resolved to increase the stability of maintaining results. It can help to prevent or reduce asymmetric growth or diseases related to the nasal cavity.

O-6

Correction of Various Malocclusion in Growing Children using Individualized Silicone Appliance

Jae Ho Baek
We.Smile orthodontic clinic

Introduction : Malocclusion in growing children can be occurred by various causes, but it is often related to bad habits. Most of the habits disturb the muscle balance, and trigger anterior crossbite, open bite, posterior discrepancy, space deficiency, and etc. A number of orthopedic and functional appliances have been used as traditional treatment. However, most of these devices require a additional tooth alignment procedure. If the causative factors can be resolved successfully and skeletodental disturbances can be repaired spontaneously, the two phase treatment will not be necessary. In this presentation, I will introduce cases in which skeletodental problems were improved with minimal artificial intervention by repairing muscle balance using individualized silicone appliance.
Case Summary : In-house silicone devices were used in this study. Construction bites were set. The difference from the conventional devices is that the amount of correction is not considered, but only the direction in construction bite. Any tooth set-up is not required also. The silicone devices were used only during sleep, and lifestyle improvement educations to remove the causative factor were conducted in daytime in parallel. The appliances could be used easily by young patients without parents' guidance because of its flexibility and non-toxicity. In addition, there was no concern about misplacement or poor retention due to the individualized tooth shape indentations. Mild space deficiency and anterior crossbite took on average 7 months for correction, and posterior crossbite and open bite took on average 12 months.
Conclusion : The silicone devices improved many malocclusion within one year by effectively restoring the muscles disturbed during sleep to their normal balanced position, and eliminated the need for additional orthodontic treatment through spontaneous recovery of muscle functions. Particularly, there is little side effect on teeth and periodontal tissues, and there is little concern about relapses as the basic principle is to induce spontaneous recovery.

O-7

Dental AVATAR; Fabrication & Application

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Introduction : In the field of orthodontic treatment, treatment simulations using digital tools are useful for accurate diagnosis and treatment planning. It helps communication with patients as well. Recently, it is even possible to create a “Dental AVATAR”, a virtual patient.
Discussion : Three kinds of imaging modalities, CBCT scan, intraoral scan, and facial scan are integrated to create a dental avatar. Previous studies have reported that the integration of facial scan with smile and intraoral scan can be used to evaluate this virtually. However, these studies have some limitations. In their facial scan images, the smile was a social smile rather than a natural smile. In addition, maintaining a smiling face was quite hard due to a long scan time. It is known that the registration accuracy is increased with a large matching area, while the registration accuracy is decreased because maxillary incisors are not sufficiently exposed in social smile. Even with some facial scanners using a laser scanning method, patients need to close their eyes.
Conclusion : The purpose of this presentation is to overcome these limitations and to introduce a method to create a digital virtual patient by combining CBCT, intraoral scan and facial scan data with a high integration accuracy. This will be helpful for accurate diagnosis and treatment planning as well as favorable communication with patients.

O-8

Establishment of a Treatment Plan to Minimize Root Exposure Due to Anterior Teeth Retraction

Yeon Hwan Kim
Wonju STM dental clinic

Introduction : In Korean orthodontic treatment, the reduction in the protrusion of lips is a major part of the patient's orthodontic treatment motivation. In order to reduce lip protrusion, posterior movement of the anterior teeth is required, and in this process, the tooth root may be exposed out of the alveolar bone. Root exposure of anterior teeth may cause necrosis of pulp tissue in severe cases, and may cause instability of anterior teeth and gingival recession during the retention period, In order to prevent this, a different approach is needed to establish an orthodontic treatment plan. Firstly, the treatment goals should be set so that the anterior teeth are located within the alveolar bone without exposure of the root. In addition, In addition, the active tooth movement plan should be established to position the anterior teeth at a set position and to maintain the position during the extraction space is closed.
Discussion : In order to set the treatment goals for the prevention of tooth root exposure, 3D digital CT imaging as well as 2D radiation imaging are essential. To achieve the set goal, the active tooth movement process must be planned in a different way than the usual way. In this lecture, I will explain how to set the treatment goal using 3D digital imaging as well as the treatment process to achieve the treatment goal
Conclusion : 1. CT images are necessary as data to check the thickness of the alveolar bone, and the amount of retraction of the anterior teeth must be determined in the CT images.
2.The occlusion of the anterior teeth, such as midline correction, normal overjet & overbite, must be achieved before the anterior teeth reaches the treatment goal.

O-9

Considerations When Conducting Orthodontic Treatment in Connection with General Dentistry in Adults

Hyungsik Yoon
Seoul Allbarun Orthodontic Clinic

Introduction : With the development of orthodontic treatment and the change of public perception, needs of adults for orthodontic treatment have been increasing. Adults often have missing teeth or prostheses. Therefore, not only the treatment plan but also the biomechanics applied during orthodontic treatment requires an approach different from that of orthodontic treatment for adolescent patients. Therefore, in order to clarify what should be considered when performing combination treatment with general dentistry, we looked back on cases from the viewpoint of a clinician.
Discussion : When orthodontic treatment is performed in connection with general dental care, the role of an orthodontist from treatment plan, actual treatment, and completion of treatment is different from that of orthodontic treatment alone. In particular, since most of these patients are adults, missing teeth, wisdom teeth, etc., or molars are inclined forward in many cases. In such a situation, the orthodontist should be able to establish an appropriate treatment plan in close communication with the general dentist and the patient, and to properly use biomechanics for the use of wisdom teeth and uprighting of molars. In this presentation, through cases treated in connection with general dental practice, the overall process of treatment, which has not been clearly arranged, and the role of orthodontists in the process, will be examined.
Conclusion : Since the occlusal state changes depending on the orthodontic treatment, it is considered rational for the orthodontists to make a comprehensive treatment plan for the orthodontic treatment linked with the general dental treatment. However, in that case, the orthodontist is premised on sufficient communication with the general dentist and the patient, and the treatment results obtained if the discussion and trust relationship between the three parties are established will be good.

O-10

How to Prevent the Betrayal of Cephalometric X-ray?

ILGON KIM
Gajirun-e orthodontic clinic

Introduction : As for orthodontists, Cephalometric X-rays are essential diagnostic data and equipment necessary for evaluating treatment outcomes and growth. However, changes in magnification cannot be avoided in replacing equipment from film to digital and upgrading digital X-rays with a brand new X-ray. For instance, a ruler attached to the Nasion relator as magnification standard only has a vertical length located on the peripheral area, which makes it challenging to inspect the distortion status of the entire image. Utilizing the fourth Cephalometric X-ray equipment in my experience, I encountered difficulties in superimposing old and new Ceph images; thus, I designed a Cephalometric X-ray phantom for Calibration and Verification.
Discussion : Phantom images for Calibration were taken from different cephalometric equipment in order to compensate for the difference in magnification ratio between types of equipment and determine the accuracy of the superimposition of phantom skull image verification. The phantom constituents include horizontal and vertical length measurement, image distortion determinants, and image gradation for evaluation. The image can be regularly taken with the phantom to identify deterioration and distortion.
Conclusion : Given these points, the calibration phantom can be a tool for quality control and superimposition of Cephalometric X-ray images. Overall, orthodontists should periodically take X-rays with a phantom and conduct X-ray image examinations to verify and validate images, preparing for future equipment replacements in advance.

O-11

Automated Analysis of 3D CBCT Images Taken in NHP Based on Multi-Deep Learning Models

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Objectives : The aims of this study were to present a complete vision-based measurement system based on combining facial profile processing and multi deep learning models for three-dimensional (3D) cone beam computed tomography (CBCT) images taken in natural head position (NHP) to measure 13 representative variables and to validate the measurements of 13 variables by comparing to them which two orthodontists and one advanced general dentist measured. The proposed system is a combination of multiple vision techniques that is adaptively utilized based on the specification of each parameter which include feature extraction for facial profile, Mask-RCNN and linear regression for teeth detection, regression CNN for landmarks detection, and decentralized CNN for teeth inclination evaluation.
Material and Methods : The CBCT images of 200 subjects (69 males, 131 females) taken in NHP according according to Solow and Tallgren's method were used for this study. 170 cases out of 200 cases were used to construct the training data set for the deep learning models and while 30 remaining cases were utilized as the validation data set to compare between the proposed methods and manual measurements. Intraclass correlation coefficient for intrarater reliability was used between two measurements by one-week interval. And, one-way ANOVA test (α=0.05) for interrater reliability were used among 4 measurements by proposed method, two orthodontists, and one advanced general dentist.
Results : All of the intraclass correlation coefficients between two manual measurements measured by one week-interval were significantly high in three raters. One-way ANOVA test (α=0.05) did not show statistically significant evidence against the null hypothesis that four populations of measurements were all equal.
Conclusion : The measurements of 13 representative variables by multi deep learning models could be an alternative for the manual measurements of 3D CBCT images taken in NHP. Therefore, we can analyze 3D CBCT Images taken in NHP automatically for orthodontic diagnosis using artificial intelligence technique.

O-12

Various Applications of Bone Age Assessment ; Expansion of Orthodontic Clinical Area

Jung suk Kim
Goun-miso dental clinic

Introduction : It is important for orthodontists to determine the growth status of growing children and to determine the timing of orthodontics. Chronologic, developmental age, handwrist X-ray , cervical vertebraes and various growth evaluations are used in clinical practice

Discussion : Recently, interest in child height growth has increased, and there are large errors among clinicians the method for evaluating facial bone and body growth.
It is still controversy to apply various growth assessment results to clinical practice but for objective and evidence-based orthodontics, various growth evaluation methods are being automated. In addition, it can help patients' needs by evaluating the adult predicted height.
Conclusion : We propose an automatic evaluation method using artificial intelligence for the bone age and growth evaluation method used in the orthodontic field. In the future, if the lateral cephalogram is analyzed at the same time when using the TW3-based artificial intelligence deep learning radiographic photo recognition program, objective and low error bone age can be obtained, and it will help predictable growth orthodontic treatment during puberty growth.. It will be helpful in orthodontic dentistry to explain to patients not only the bone age of the facial skeleton, but also information about adult predictive height and advanced growth or growth retardation.

O-13

효율적인 비발치 교정치료를 위한 변형된 구개확장장치의 치험례

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BABA orthodontics

Introduction : Due to the nature of Asians, careful control of the posterior teeth is required for non-extraction treatment. Compared to Westerners, Asian's nose is lower and the development of pogonion is weak, so slight protruding of the anterior teeth make the facial profile worse.
Therefore, in the case of non-extraction treatment, in most cases, obtaining the maximum molar expansion and distalization of the maxillary molar must be preceded.
However, if this work is done separately, it will take quite a long treatment time, and a lot of additional equipment costs are needed. And from a doctor's point of view, replacing the device in the middle of treatment is not an easy work.
Therefore, this presentation intends to present cases in which these problems were solved more simply and efficiently.
Case Summary : case 1.
This patient was an adult male patient with class 1 skeleton and his CC was crowding of the upper and lower anterior teeth. A modified MSE (maxillary skeletal expander) was used.

case 2.
This patient was a class 2 skeletal adolescent male patient whose CC was the crowding of the upper and lower anterior teeth. A modified Hyrax type RPE was used.

case 3.
This patient was a class 3 skeletal adolescent female patient. Her chief complaint was crowding of anterior teeth and anterior crossbite. A modified MSE was used.
Conclusion : If the existing palatal device is modified and those devices can perform various functions simultaneously, it is expected that more efficient and rapid treatment will be possible.

O-14

Accuracy of Artificial Intelligence-assisted Landmark Identification in Serial Lateral Cephalograms

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Objectives : To compare the accuracy of artificial intelligence (AI)-assisted landmark identification (LI) in serial lateral cephalograms (Lat-cephs) of Class III (C-III) patients who underwent two-jaw orthognathic surgery using a convolutional neural network CNN) algorithm.
Material and Methods : 3,188 Lat-cephs of C-III patients were allocated into the training and validation sets (3,004 Lat-cephs of 751 patients) and test set (184 Lat-cephs of 46 patients; subdivided into the genioplasty and non-genioplasty groups, n=23 per group)] for LI using a CNN model. Each C-III patient in the test set had four Lat-cephs: initial (T0), pre-surgery [T1, presence of orthodontic brackets (OBs)], post-surgery [T2, presence of OBs and surgical plates and screws (S-PS)], and debonding [T3, presence of S-PS and fixed retainers (FR)]. After mean errors of 20 landmarks between human gold standard and the CNN model were calculated, statistical analysis was performed.
Results : The total mean error was 1.17 mm without significant difference among four time-points (T0, 1.20 mm; T1, 1.14 mm; T2, 1.18 mm; T3, 1.15 mm). In comparison of two time-points [(T0, T1) vs. (T2, T3)], ANS, A point, and B point showed an increase in error ($P < 0.01$, 0.05, 0.01, respectively), while Mx6D and Md6D showed a decrease in error (all $P < 0.01$). No difference in errors existed at B point, Pogonion, Menton, Md1C, and Md1R between the genioplasty and non-genioplasty groups.
Conclusion : The CNN model can be used for LI in serial Lat-cephs despite presence of OB, S-PS, FR, genioplasty, and bone remodeling.

O-15

Modified Bonded Cantilever Spring for Uprighting Horizontally Impacted Lower Third Molar

Seung-Min Lim
Gajirunee orthodontic clinic

Introduction : It has been reported that a maxillary or a mandibular permanent third molar was uprighted and acceptably replaced the second molar after extraction in orthodontic treatment. The alignment of the permanent third molars after the extraction of the permanent first or second molars is a useful option for adult patients when the permanent first or second molars are severely damaged.
Discussion : Several orthodontic mechanics and devices have been proposed to verticalize and disimpact the mesially tipped mandibular molars. Removable and fixed appliances and, more recently, skeletal anchorage have been used with push springs, open-coil and closed-coil springs tip-back cantilevers, looped springs to perform the challenging task of uprighting tipped molars. A clinical advantage of the modified bonded cantilever spring is that it does not depend on exposure of the buccal surface of the tooth for bonding of orthodontic tube, as generally required by conventional cantilevers, because this area is frequently unavailable in patients with extremely tipped and partially erupted mandibular molars. Another mechanical advantage is that the moment produced by the modified bonded cantilever spring, unlike some uprighting mechanics, does not depend on any distal force. Extremely tipped mandibular molars frequently have the center of resistance close to the line of action of the distal forces, generating reduced moments of force and tending to produce distal bodily movement of the tipped molar, which can reduce molar uprighting efficiency. Therefore, this mechanical characteristic can be an effective method when root movement is prioritized.
Conclusion : The modified bonded cantilever spring is an effective mechanics for uprighting of horizontally impacted lower third molar without surgical exposure of buccal tooth surface.

O-16

Distalization Pattern of the Maxillary Molars During Total Arch Distalization: Tipping or Bodily Movement?

Junkyu Jang
Seoulbarun E orthodontic clinic

Objectives : Interradicular miniscrews provide sufficient anchorage for molar distalization without mesial movement of the anterior teeth. The amount of distal movement and tipping of the molars varied considerably depending on the article. The aims of this study were to evaluate the amount of distal movement and change of axis of maxillary posterior teeth and to confirm the factors affecting change of axis during total arch distalization with interradicular miniscrews.
Material and Methods : The inclusion criteria were as follows
(1) Patients over 18 years old without craniofacial deformity
(2) Patients who had any adjunctive appliances, such as rapid palatal expander, headgear or any removable appliance were excluded.
(3) The amount of distalization of posterior teeth > 2mm

A total of 21 subjects (3 male, 18 female, average age: 26.0y) were collected by one investigator.
Pretreatment and posttreatment lateral cephalograms were used for analysis. Three angular measurements were taken to evaluate axis changes of maxillary posterior teeth before and after orthodontic treatment.
Results : Mean orthodontic treatment duration was 23.6 months. There were no significant differences in skeletal measurements between pretreatment and posttreatment. The mean amount of molar distalization was 3.0 mm. The amounts of tipping of first and second maxillary molars were +0.8° and -4.6° respectively. Because most of maxillary 2nd molars' crowns were distally tilted before treatment, the distal movements of root apex were greater than those of crown.
Conclusion : Tipping of the molars was found to be minimal during total arch distalization with interradicular miniscrews. The factors affecting tipping of molars were play between wire and tubes, clockwise rotation of maxillary occlusal plane and the amount of tilting of molars before treatment.

O-17

the Morphologic Change of Palatal Alveolar Bone Shape after Intrusion and Retraction of Maxillary Incisors

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Objectives : The purpose of this study is to evaluate the changes in the palatal alveolar bone thickness and find the factors related to the resorption of the palatal alveolar bone caused by tooth movement after the maxillary incisors were retracted and intruded during orthodontic treatment.
Material and Methods : The study group comprised of 33 skeletal Class II malocclusion patients who underwent extraction for orthodontic treatment. Palatal alveolar bone thickness changes and resorption factors were identified and analyzed. The changes of maxillary central incisors and palatal alveolar bone thickness were measured, and the corresponding sample T-test was performed using SPSS (IBM SPSS version22). The amount of palatal alveolar bone resorption was measured and various parameters were analyzed to determine which factors affected it.
Results : Correlation analysis adopting the amount of palatal alveolar bone resorption as a dependent variable demonstrated that the SNB, mandibular plane angle, and the inclination of the maxillary central incisor were significantly correlated with before treatment. On the other hand, mandibular plane angle, angle of convexity, the inclination of the upper incisor, and the occlusal plane (UOP, POP) were significantly correlated with post-treatment. In addition, the variables related to palatal contour (PP to PAS, SN to PAS, palatal surface angle) and occlusal planes (UOP/POP) were significantly correlated with the difference in palatal bone resorption.
Conclusion : During initial diagnosis, high angle class II with normal upper incisor inclination can be signs of high-risk factors. In addition, maintaining the occlusal plane during treatment helps to prevent palatal bone loss.

O-18

7 Years Twin Study - Influence of Heritability on the Craniofacial Hard and Soft Tissue Characteristics

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Objectives : To investigate the influence of heritability on the craniofacial cephalometric characteristics of monozygotic(MZ) twins, dizygotic(DZ) twins, and their siblings(SIB) and to find highly heritable parts of craniofacial structures and applicate the findings in the diagnosis and treatment planning.
Material and Methods : The samples comprised Korean adult twins and their siblings (mean age, 39.8 years; MZ group, n = 36 pairs; DZ group, n = 13 pairs of the same gender; and SIB group, n = 26 pairs of the same gender). Cephalometric hard and soft tissue variables were measured to describe the size and shape of the facial horizontal and vertical, dental, mandible and cranial base structure and to characterize facial profile, facial height, soft tissue thickness, and projection of nose and lip. Falconer's method was used to calculate heritability (low heritability, $h2 < 0.2$; high heritability, $h2 > 0.9$).
Results : The MZ group exhibited higher ICC values for all cephalometric variables than DZ and SIB groups. The mean of the hard tissue ICC and the soft tissue ICC were similar in each group. Among hard tissue cephalometric variables, the high h2 values were shown at SNA, SNB, SN-Pog, SN-palatal plane angle, SN-mandibular plane angle, N-ANS/ANS-Me, and ANS-Me/N-Me. SN-occlusal plane angle, L1-Occlusal plane angle, and lower gonial angle, mandibular body length, cranial base angle also showed high h2 values. Among soft tissue cephalometric variables, the high h2 values were observed for the nasolabial angle, chin angle, soft tissue chin thickness, and upper lip thickness ratio.
Conclusion : The shape of facial skeletal structure and location of the occlusal plane on the craniofacial hard tissue characteristics, and the nose and soft tissue chin on the craniofacial soft tissue characteristics were more influenced by genetic factors. While orthodontic treatment, careful approach is needed prior to changing craniofacial parameters that are under strong genetic influences.

O-19

The Role of 3D Printing in Digital Orthodontics

Gi-Sun Bae
SUN ORTHODONTIC CLINIC

Introduction : With the developments of CAD/CAM and Rapid Prototyping technologies in digital dentistry, there have been various attempts to introduce the 3D printer in the area of orthodontic treatment. The 3D printer in an orthodontic office can be used to make a diagnostic model, a bracket transfer tray for indirect bonding, a temporary splint, and mainly, a digital clear aligner.
The digital clear aligner is one of the most favored orthodontic methods opted for by adult patients. However, the use of the clear aligner is associated with various clinical challenges. Due to the structural characteristics of the aligner, it is not easy to make proper posterior occlusion and specific types of tooth movement, including extrusion, rotation, and tip, which makes the treatment time become longer. Moreover, making clear aligners with the 3D printer is a tiresome, annoying, and time-consuming process.
To overcome those limitations of digital clear aligner treatment, we have developed a fully customized bracket manufacturing method for an individual patient with direct 3D resin printing in the office for efficient and precise digital orthodontic treatment.
The primary advantage of the direct manufacture of an orthodontic bracket by the 3D printer is that the shape or size of the bracket can be modified almost limitlessly. If necessary, the number, location, and shape of slots can also be changed as much as required. More efficient tooth movement is possible, and further, adjustment by wire bending can be minimized.
A new protocol for direct 3D printing of orthodontic brackets will help perform digital orthodontics more efficiently and accurately. It is expected that an appropriate combination of two strands of light round wire and the 3D-printed bracket whose design can readily be changed by the practitioner's treatment strategy will provide an infinite potential for orthodontic biomechanics.

O-20

Gummy Smile Correction in Lingual Orthodontics

Joong-Ki Lim
Yon Dental Clinic

Introduction : A gummy smile is one of the most difficult malocclusions to treat in the conventional orthodontics. There are various causes of gummy smiles. They could be divided into two categories, one is related to the hard tissue of maxilla and alveolar bone, and the other is to the soft tissue. A hard tissue problem means (1) horizontal maxillary excess, (2) vertical maxillary excess, (3) horizontal dentoalveolar excess, and (4) vertical dentoalveolar excess. A soft tissue problem contains overgrowth of the gingiva, over-activation of smiling muscles and short philtrum.

Discussion : To improve gummy smile with the orthodontic treatment, upper incisor intrusion has been conducted. However, by the law of action and reaction, compensatory extrusion of the upper posterior teeth was occurred simultaneously. As a result, it is hard to get satisfactory treatment results. The recent introduction of the mini-implant made the absolute intrusion of the upper incisor possible, so that the treatment of the gummy smile was revolutionary changed.
Conclusion : When correcting gummy smile with the lingual appliance, there are several advantages compared to the labial one. Since the force application point is located close to the center of resistance, intrusion force acts more efficiently. Lingual appliance containing upper anterior bite plate is useful for overbite control. Additional application of mini-implants allowed the upper incisor to intrude to a greater extent

In this presentation, I will discuss the differential diagnosis according to the etiology of the gummy smile and biomechanical differences between lingual and labial appliance. Furthermore, I will review the case of the gummy smile correction through the lingual appliance (with/without mini-implant). In particular, I would like to introduce a new method that has recently been improved based on my clinical experience in the lingual treatment using mini implants.

P-001

The Effect of Third Molar Presence on Maxillary Posterior Bone Availability in Different Maxillary Type

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Purpose : The purpose of this study is to compare posterior bone availability for maxillary molars distalization in maxillary tuberosity area between patients with the presence and absence of the third molar in the prognathic, orthognathic, and retrognathic maxilla.
Materials and methods : Sixty maxillary tuberosity areas with prognathic, orthognathic, and retrognathic maxilla between the ages of 18 and 50 years were studied, using cone-beam computed tomography. Posterior bone availability was measured at root levels. The distances between the mid-distal of distobuccal roots of the maxillary second molar and the inner cortex of the maxillary tuberosity were measured parallel to the posterior occlusal line at depths 6, 8, and 10 mm apical to the cementoenamel junction of the second maxillary molar. Data was collected and analyzed statistically.
Results : Orthognathic maxilla, the presence of the third molar group has significantly greater posterior bone availability than the absence of the third molar group at all depths (p
Conclusions : In all types of maxillas, the presence of a third molar correlates with greater posterior bone availability for maxillary molars distalization.

P-002

Pulpal Microvasculature Changes During Orthodontic Loading: A histomorphological Study in Human

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Purpose : The purpose of the present study was to perform a quantitative and qualitative evaluation of the histological pulpal micro vascularity changes and angiogenesis following the orthodontic loading application in humans.
Materials and methods : Twelve third molars that were loaded with a 0.016-inch Sentalloy archwire for 1, 3, 4, and 8 weeks were used in the study. Follow extraction, specimens were fixed, embedded, and stained with CD 164 marker for endothelial cell lineage. The quantification of blood vessels in histological sections (vascularity) was made with an image analyzer and the mean number of blood vessels was calculated.
Results : There was a significant great increase in vascularity in the 1-week group compared to the other groups. However, the new blood vessels had small diameters and were congested with red blood cells inside. In the 3 and 4 weeks groups, the vascularity was similar to the control group. However, the blood vessels had a larger diameter than the 1-week group with signs of congestion. In 8 weeks group, the sizes of blood vessels were larger than in the control group with no signs of congestion.
Conclusions : Angiogenesis is a critical aspect of dental pulp regeneration and homeostasis and can be observed histologically in the first week following orthodontic loading.

P-003

Effect of Orthodontic Loading on the Thickness of Periodontal Ligament Proliferation

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Purpose : The purpose of the present study was to determine the changes of remaining periodontal ligament (PDL) thickness on the root surface of extracted premolars following orthodontic loading.
Materials and methods : Forty premolars were divided into control and preloaded (4, 8, and >12 weeks) groups. Premolars were extracted, fixed, and stained with toluidine blue for the assessment of the remaining PDL. The radicular portion was divided into apical, middle, and coronal thirds. Images of the buccal, lingual, mesial, and distal surfaces were recorded under a stereomicroscope and the PDL thickness was measured with ImageJ software. Data was collected and analyzed statistically.
Results : The preloading group (4, 8, and >12 weeks) significantly increased the overall PDL thickness compared to the control (p12 weeks group exhibited a significant decrease in PDL thickness compared to the 8 weeks group and similar to the 4-week group, therefore indicating a PDL thickness rebound.
Conclusions : The 8-weeks orthodontic preloading duration provided the highest increase in the PDL thickness. After this period, the PDL thickness rebounded, therefore suggesting the homeostasis and repair of the PDL and surrounding alveolar bone.

P-004

Incisive canal remodelling following maximum anterior retraction reduces apical root resorption

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Objectives : The objectives were to visualize the incisive canal (IC) remodelling following maximum incisor retraction and to evaluate its impact on canal-invasion associated apical root resorption.
Material and Methods : Pre- and post-treatment CBCT images of 34 adult orthodontic patients (age 18-47 years) with a large amount of maxillary incisor retraction (>4 mm) using temporary anchorage devices (TADs) were retrospectively evaluated. Maxillary regional superimpositions and 3D models of the IC along with central incisors were used to measure the changes in IC dimension, IC invasion by the roots and IC remodelling. In addition, the association of the amount of apical root resorption with the root-IC relationship and IC remodelling were evaluated.
Results : IC invasion by the incisor roots following maximum retraction was seen in 53% (18 out of 34) of the cases. IC with larger volume and area showed more invasions compared with those with smaller volume and area ($P < .01$). The amount of root resorption was significantly higher with IC invasion than without invasion (2.39 mm vs 0.82 mm, $P < .0001$). IC remodelling following maximum retraction was seen in 24% of the subjects. IC remodelling group demonstrated less apical root resorption than the non-remodelling group (0.98 mm vs 3.27 mm, $P < .0001$).
Conclusion : IC with larger volume and surface area before treatment were more likely to show canal invasion by the incisor roots after maximum retraction. IC invasion resulted in apical root resorption. However, approximately one-fourth of cases showed remodelling of the IC, which reduced the amount of root resorption.

P-005

3D-Finite Element Analysis According to the Location And Length of TAD During Skeletal Transverse Expansion

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Objectives : The purpose of this study was to evaluate mechanically displacement of teeth and alveolar bone according to the location of microimplant-assisted rapid palatal expansion appliance(MARPE) and length of micro-implnat during skeletal transverse expansion.
Material and Methods : A three dimensional (3D) finite-element (FE) model of the craniofacial bones and maxillary teeth was obtained.
Three designs of rapid maxillary expanders: one with micro-implants placed lateral to mid-palatal suture (Type 1), the second at micro-implants anterior than type1's (Type 2), the third at micro-implants anterior than type2's (Type 3). Expanders were activated transversely for 0.25mm.
For FE analysis, the following software progrmas were used: Visual-Crash for PAM Version 16.5 for meshing, VPS Version 2020 for solving, and Visual-Viewer Version 16.5 for postprocessing(ESI Group,France). Geometric nonlinear theory was applied to evaluate Von-Mises Stress distribution and displacement.
Results : In all types, maximun stress was concentreated on micro-implant site.
Type 3 showed overal expansion on anterior and posterior part. On the other hand, Type 2 showed the least effect of maxillary expansion. But type 3 showed more buccal inclination of the dentition in addition to the buccal rotational movement of the alveolar bone.
Conclusion : Type 3 showed more expansion in teeth and alveolar boen than the othe types, but also showed more inclination of the dentition.

P-006

Morphology of Mandibular Buccal Shelf in Skeletal Class III Malocclusion Patients with Different Vertical Patterns

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Objectives : The purpose of this study is to compare differences in morphological characteristics of the mandibular buccal shelf in skeletal Class III patients with different vertical patterns using a cone-beam-computed tomography (CBCT).
Material and Methods : The mandibular buccal shelves of a total of 48 patients aged 18-30 years old, 16 subjects in each group with different vertical patterns (hypodivergent, normodivergent, hyperdivergent) with skeletal III Class malocclusion, were evaluated using CBCT. All angles were measured against the occlusal plane. About the buccal shelf, buccolingual slope angle (S), horizontal cortical bone thickness (HCBT), and horizontal buccal bone thickness (HBT) were measured respectively in the four coronal sections and anteroposterior slope angles (APS) was measured in the sagittal plane.
Results : The APS showed a significant difference between the groups ($p<0.05$), lower angle in hyperdivergent group, higher angle in hypodivergent group. The correlation analysis showed a negative correlation with the parameters showing vertical skeletal patterns ($p<0.01$). There was no significant difference in the S and the HBT between groups. The thickness of the cortical bone showed significant differences between the groups and tended to become thinner in order of hypodivergent, normodivergent, and hyperdivergent groups.
Conclusion : The anteroposterior angle of the mandibular buccal shelf of skeletal Class III malocclusion patients showed a tendency to flatten as the facial vertical dimension increased. The thickness of the cortical bone tended to decrease with the increase of the vertical dimension, and the buccolingual angle and the buccal bone thickness of the mandibular buccal shelf were not affected by the vertical dimension.

P-007

Cone-beam Computed Tomography Evaluation of Root Resorption after Maxillary Distalization in Class II with Pneumatization

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Objectives : The purpose of this study was to evaluate the volume of root resorption of the maxillary posterior teeth after total arch distalization through maxillary sinus with modified C-palatal plate (MCPP) using cone-beam computed tomography (CBCT).
Material and Methods : Twenty CBCT images were obtained from ten patients (4 male, 6 female; mean age, 21.0 years; range, 15.3 to 28.9 years) before (T1) and after (T2) total maxillary arch distalization by MCPP. The samples were divided into two groups according to maxillary sinus pneumatization. Group 1 was pneumatization group (n=10) and Group 2 was non-pneumatization group (n=10). CBCT images were taken by an iCAT scanner (Imaging Science International, Hatfield, Pa, USA). Three-dimensional volume rendering was conducted by InVivo software (version 5.2; Anatomage, San Jose, CA, USA) to measure the volume loss of posterior teeth. Paired t test and an independent sample t test were used for the comparisons of the change.
Results : There was no significant difference in the amount of root resorption between Group 1 and 2, except for the maxillary first molar. The maxillary first molar showed more root resorption in the pneumatization group (p=0.015). The volume loss of the maxillary first molar was 63.60 ㎣ in Group 1 and 41.00 ㎣ in Group 2.
Conclusion : Tooth movement through the maxillary sinus floor induced root resorption of posterior teeth, especially the maxillary first molars.

P-008

Evaluation of Factors Affecting Soft Tissue Compensation in Skeletal Class III Patients with Facial Asymmetry

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Objectives : The purpose of this study was to evaluate the factors affecting the soft tissue compensation in the skeletal Class III patients with a facial asymmetry.
Material and Methods : The participants consisted of 31 skeletal Class III patients (15 men and 16 women; mean age, 22.27 ± 4.18 years) with menton deviation greater than 3.0 mm based on midsagittal plane (MSP). The CBCT images were reconstructed using OnDemand3D 1.0 software (Cybermed, Seoul, Korea). The deviations of landmarks were measured based on MSP, and paired t-test was performed to test the soft tissue compensation. The correlations between soft tissue compensation and hard tissue deviation, degree of skeletal class III malocclusion (ANB), lower anterior facial height ratio (LFHR), and soft tissue thickness were evaluated using Pearson correlation coefficient and regression analysis.
Results : The soft tissue compensation was demonstrated by the difference between the deviation of hard tissue from the corresponding soft tissue ($p < 0.01$). There were significant positive correlations between the soft tissue compensation of B and pogonion deviation but negative correlation with LFHR ($p < 0.05$). The soft tissue compensation of pogonion showed positive correlations with deviation of pogonion and menton, but negative correlation with LFHR ($p < 0.05$). There was no significant correlation between the soft tissue compensation of menton and every variables ($p < 0.05$). At gonion, soft tissue compensation showed significant positive correlations with deviation of pogonion and menton ($p < 0.05$).
Conclusion : The hard tissue deviation was compensated by soft tissue in skeletal Class III patients with facial asymmetry. The greater pogonion and menton deviation and the smaller lower anterior facial height ratio, the more soft tissue compensation.

P-009

Evaluation of Genial tubercles According to Vertical patterns in Skeletal Class II with Retrusive mandible

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Objectives : The purpose of this study was to investigate the distribution of the morphological pattern of the genial tubercles (GTs) and to assess the dimensions and position of the GTs in skeletal Class II malocclusion adult patients with retrusive mandible according to the vertical skeletal patterns using cone beam computed tomography (CBCT) images.
Material and Methods : CBCT records of 140 Korean adult patients were retrospectively collected and analyzed. The subjects who had sagittal skeletal Class II pattern with normal maxilla and retrusive mandible were divided into 3 groups by FH-MP angle (mandibular plane angle to the Frankfort horizontal line). The CBCT images were investigated to assess the morphological pattern, dimensions and position of the GTs using OnDemand3D 1.0 software (Cybermed, Seoul, Korea).
Results : The most common morphological pattern was two superior GTs and a rough impression below them (54.3%). For dimensions and position of the GTs, AMT was statistically thick in hypodivergent group ($p < 0.05$). According to the 2-way analysis of variance (ANOVA) analysis, effect of vertical skeletal patterns was significant only in AMT ($p < 0.05$) and effects of gender were significant on all measurements except IGT-IBM ($p < 0.05$).
Conclusion : In skeletal Class II with retrusive mandible adults, the most common morphological pattern of the GTs was two superior GTs and a rough impression below them. AMT was thicker in hypodivergent group and the dimensions of the GTs in males were generally larger than those of females.

P-010

Effect of Observer's Sex and Chin Prominences on the Perception of the Lip-Chin Prominence Angle

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Objectives : This study aimed to identify the preferred range of lower lip-chin prominence angles in the Korean population and evaluate the effect of the individual lower lip-chin prominence angle on perceptions of esthetic chin profile.
Material and Methods : Chin prominence silhouettes were used to assess the lower lip-chin prominence preference. The observers randomly categorized each image as 1) normal, 2) slightly abnormal but not requiring surgical correction, and 3) abnormal and requiring surgery. Individual lower-chin prominence angles of all observers were analyzed using standardized clinical photographs.
The chi-squared test was performed to compare chin prominence preferences between men and women. To classify chin prominence angle into three groups (normal, socially acceptable, surgery needed), the category of chin prominence was determined using Kaplan-Meier curve, and log-rank test was used to compare categories between men and women.
Results : The normal range of lower lip-chin prominence angle is 0°–25°; socially acceptable range is 0°–-10°, 25°–40°; range needing surgery is -10°–-30° and 40°–45°. Women are more tolerant to chin protrusion. A protrusive chin is more acceptable in observers with retrusive chin profile.
Conclusion : Skeletal Class II profile could be more acceptable than skeletal Class III in the Korean population. Moreover, women are more tolerant of the chin protrusion. The individual lower lip-chin prominence angle could affect perception of desired surgery. These highlights could be helpful in the patient-specific evaluation of chin surgery.

P-011

Evaluation of Proximity of Mandibular Molar Roots and Lingual Cortical Bone in Different Facial Patterns

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Objectives : We evaluated the proximity of the mandibular molar roots to the lingual cortical bone based on vertical facial patterns and identified associated factors.
Material and Methods : Total 145 patients (84 males, 61 females, mean age: 22.0±1.76 years) were assigned to hypodivergent (36 patients), normodivergent (80 patients), and hyperdivergent (29 patients) groups based on facial height ratio. The distance and contact between mandibular molar roots and lingual cortical bone was measured using cone beam computed tomography (CBCT) images and effects of sex and cephalogram measurements were also assessed.
Results : Mandibular molar roots and lingual cortical bone was significantly closer in hyperdivergent group than in hypodivergent group ($p < 0.05$). Overall, 87.6% of total root-lingual cortical bone contact was observed in the mandibular second molar, and the contact rate of the distal roots of the mandibular second molar was greatest in hyperdivergent group at 43.1% ($p < 0.05$). Every 1 mm increase in the distance between distal root apex of the mandibular second molar and mandibular plane decreased the chance of contact between mandibular second molar roots and lingual cortical bone by 22% ($p < 0.001$).
Conclusion : Hyperdivergent facial pattern had less distance and increased chance of contact between mandibular molar and lingual cortical bone. The probability of contact between mandibular second molar and lingual cortical bone increases as the root apex of mandibular second molar is closer to the mandibular plane. A CBCT evaluation is recommended if molar distalization or intrusion is planned in hyperdivergent patients.

P-012

Effect of strontium treatment on osseointegration of Ti-6Al-4V orthodontic miniscrew treated with anodization and pre-calcification

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Objectives : The purpose of this study was to evaluate the effect of strontium, which induces osteoblast activity and osteoclast inhibition, on osseointegration and initial stability in orthodontic miniscrews treated with anodization and pre-calcification to improve biocompatibility.
Material and Methods : The orthodontic miniscrew surface was anodized and cyclic precalcified treatment to provide a large surface area to increase bioactivity. In addition, to investigate the effect of strontium, inorganic compounds $Sr(OH)_2$ and strontium ranelate were treated on the surface of the miniscrew. The miniscrew surface treatment was tested for cytotoxicity using MTT assay, and was immersed in SBF for 1 day to evaluate the bioactivity in vitro. To evaluate the effect of improved bioactivity on osseointegration in vivo, a miniscrew was implanted into the rat's tibia, and the removal torque and implanted tissue were observed 4 weeks later.
Results : A fine granular cluster layer of hydroxyapatite and octacalcium phosphate was formed on the surface of the miniscrews subjected to anodization and pre-calcification treatment. As a result of immersion in the SBF for 1 day, it was confirmed that the bioactivity was improved. As a result of measuring the removal torque of miniscrews implanted in rat tibia for 4 weeks in an in-vivo experiment, there was a statistically significant difference in the group treated with strontium. From the observation of tissue specimens, it was confirmed that the initial osteogenesis in the strontium-treated group proceeded from the surface of the miniscrew to the basal bone.
Conclusion : As a result of this study, strontium treatment improved osseointegration in orthodontic miniscrews treated with anodization and pre-calcification.

P-013

Thermo-Mechanical Properties of 3D Printed Photocurable Resin with Shape Memory Property for Transparent Orthodontic Aligners.

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Objectives : The purpose of this study is to evaluate the thermo-mechanical and viscoelastic properties of photocurable resin, a new material for direct 3D printed TOAs. In addition, the shape memory property of the new material was evaluated to estimate the clinical feasibility.
Material and Methods : Thermoplastic material (PETG) was vacuum thermoformed on a standardized model, and then cut out to make specimens. The specimens of photocurable resin material (TC-85) were printed with a DLP type 3D printer. Thermo-mechanical properties including tensile modulus, stress relaxation and creep effect were measured. DMA was performed to analyze the mechanical behaviors of the two materials. Furthermore, shape memory property was evaluated by investigating the shape recovery ratio.
Results : After thermoforming, the thickness of PETG decreased to 54.7%, and TC-85 was printed 12% thicker than the set value. At 25℃ and 55% humidity, PETG showed higher stiffness than TC-85, and TC-85 showed a larger elastic range than PETG. At 37 °C, TC-85 showed more viscous behavior than PETG, showing a greater amount of stress relaxation and gradual strain recovery. As the load and recovery cycles were repeated, the residual static force and strain recovery speed of TC-85 were improved, but those of PETG were constant. At 80 °C, TC-85 showed little stress relaxation and showed a constant pattern of strain recovery, demonstrating geometric stability. PETG showed a large amount of stress relaxation and thermal shrinkage (geometric instability) at high temperature (80 ℃).
Conclusion : 3D printed photocurable resin can apply light and constant force to teeth by flexible mechanical property and viscoelastic property. In addition, with the creep behavior that the static force is gradually improved as the repeated load, it can be expected that the force decay induced by repeated insertion of the TOAs is reduced and the constant orthodontic force is maintained.

P-014

Osteogenic Effect of Partially Demineralized Autogenous Tooth Bone and Three Other Bone Graft Materials

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Objectives : Partially Demineralized Autogenous Tooth Bone (PDATB) that uses both inorganic and organic matter of extracted tooth can be clinically used as a novel bone graft material. The purpose of this study is to compare biodegradability and the speed of bone reconstruction between PDATB and other bone graft materials by using rabbit models with tooth extraction defects.
Material and Methods : Three different types of bone graft materials, including Deproteinized Bovine Bone Mineral (DBBM), Biphasic Calcium Phosphates (BCPs), and Autogenous Tooth Bone (ATB), were implanted on one side of tooth extraction defects of 18 adult New Zealand white rabbits and compared with PDATB implanted on the other side. The control group without any bone graft materials was compared with the treatment group, and bone repair process was analyzed on the 4th, 8th, and 12th week.
Results : In-vivo comparison results between PDATB and other bone graft materials indicated that the treatment group with PDATB exhibited significantly rapid resorption upon bone regeneration, whereas DBBM and BCPs caused limited dispersed distributes of bony ingrowth. Mineral deposition rate (MAR) of treatment group treated with PDATB implanted on the defection area on maxilla, which was measured on 4th, 8th, and 12th week , was significantly larger than groups treated with DBBM and unprocessed ATB. Results of bone formation with PDATB on the defection area on mandibular also exhibited similar results.
Conclusion : Bone deposition of the treatment group treated with PDATB exhibited increased stability and better support in terms of osteoconductivity, osteoinduction, and bone regeneration. It is deemed that the development of an adaptive bone frame using PDATB could contribute to enhancing functional recovery of craniofacial bone defection.

P-015

Bioactive antibacterial modification of orthodontic microimplants using chitosan biopolymer

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Objectives : Recently, chitosan has been immobilized on the surface of orthodontic appliances to prevent bacterial adhesion and colonization, as its antibacterial and hydrophilic properties have been shown to effectively prevent the formation of biofilms.
In this study, we chemically bonded chitosan onto the surface of TiAl6V4 alloy-based orthodontic microimplants to enhance their bioactive- and antibacterial properties, thereby promoting more rapid integration with bone tissue but reduced harmful release of metal ions in the clinical situation.
Material and Methods : Microimplants and disk-shaped specimens were obtained from Dentos Inc., Daegu, Korea. The TI specimens, prepared by cutting a Ti6AL4V alloy rod, were used for process simulation and validation tests to prevent difficulties associated with testing small microimplants with complex shapes.
The covalent bonding of chitosan to microimplant (or TI) surfaces was carried out using a three-step reaction: amino-functionalization with 3-aminopropyltriethoxysilane (APTES), followed by grafting with a spacer (either succinic- or polyacrylic acid), finally followed by chitosan attachment.
Mouse pre-osteoblastic cells (MC3T3-E1), used to evaluate the cellular response to the chitosan-bonded surfaces.
The anti-bacterial ability of a protective chitosan coating on microimplants was evaluated in vitro by seeding Streptococcus mutans and Streptococcus sobrinus stains on neat TI and TI-SA-Ch specimens.
Results : The results, indicate that TI-SA-Ch effectively reduced biofilm formation in both Streptococcus mutans and Streptococcus sobrinus. The presence of a thin layer of water at the hydrophilic surface of chitosan might be responsible for this suppression of bacterial activity, as similar activities have been reported with super-hydrophilic films of oranano-silicates. Interestingly, chitosan modification was more effective at suppressing Streptococcus mutans than Streptococcus sobrinus.
Conclusion : Surface modification with chitosan may enhance the stability, antibacterial properties, and eventually improve the clinical performance of the titanium alloy (Ti6Al4V) based microimplants, and reduce the metal ion-related allergies and sensitivity occasionally noticed after their placement.

P-016

Changes in Physical Properties of Clear Removable Orthodontic Aligners After Use

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Objectives : The purpose of this investigation is to evaluate the changes in physical properties such as thickness, flexural force and tensile force before and after use of clear removable orthodontic aligners.
Material and Methods : Ten treatment stages of maxillary canine retraction during space closure were randomly selected. Next, the selected space closing stage (n stage) and its following stage (n+1 stage) aligners as well as maxillary casts at n stage were prepared. To simulate clinical use of 2-week period, aligners at n+1 stage were placed on the casts at n stage and kept in a humidor at 37℃ for 2 weeks except for its removal and re-application 5 times each day to simulate food intake routine. For thickness, the points on canine distal occlusal angles were measured by a micrometer 3 times each and their mean values were used for analysis. Flexural and tensile force was measured at 0.25mm, 0.5mm, 1.0mm and maximum displacement. Descriptive statistics, Shapiro-Wilk test, and t-tests were done and the statistical significance was set at $p < 0.5$.
Results : The mean thickness of aligners was significantly decreased by 18% from 0.83±0.14mm to 0.68±0.06mm after use ($p < 0.001$). The flexural forces at 0.25mm, 0.5mm, 1.0mm displacement and the maximum flexural force magnitude displayed no statistical differences between the two groups. Also, the tensile strength consistently showed that the force level decreased after use at 0.25mm, 0.5mm, 1mm and at the maximum stretch, but no statistically significant difference was found.

Conclusion : Though thickness of the clear removable orthodontic aligners was significantly reduced, the force delivery characteristics involving flexural and tensile strength remained mainly intact after 2 weeks of use.

P-017

Mechanical and chemical effects of polysilsesquioxane nano-coating on clear overlay appliances

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Objectives : Clear overlay appliances (COAs) are widely used in orthodontic fields however, it has limitation of easy fracture and abrasion. To improve the durability of COAs in clinical use, the aim of this study was to analyze the impact of polysilsesquioxane (PSQ) coating on improving the mechanical properties and enhance chemical stability of COAs.
Material and Methods : PSQ, a composite of tetraethylorthosilicate and 3-(trimethoxysilyl)-propyldimethyloctide ammonium chloride, was coated on substrates through a simple dipping method. The coated group divided into PSQ-nano, and PSQ-mico group according to the film thickness. Mechanical properties were evaluated with wear resistance test and repeated loading test under simulated dynamic oral condition. The chemical resistance test was performed to identify thickness changes under different pH condition and salivary enzymes.
Results : Mechanical tests showed that coated group enhanced the mechanical properties of wear resistance and crack resistance than control group. The PSQ-nano group showed less weight loss under wear resistance test, and shallower crack depth under loading test compared with PSQ-micro group.
The chemical test showed that the thickness reduction over a 2 weeks under acidity conditions was relatively stable in PSQ-nano group than in PSQ-micro group. The PSQ coating was more susceptible to degradation by enzymatic condition than by pH in both groups.
Conclusion : The nanoscale PSQ films improved the mechanical properties (wear resistance and crack resistance) and showed good chemical stability. It would be expected that PSQ film is able to overcome the inherent weakness of thermoplastic polymer used in COAs.

P-018

Simultaneous versus “en masse” Distalization of Maxillary Molars with iPanda: A Finite Element Analysis

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Purpose : To compare the stress distribution and displacement patterns between the “en masse” versus the simultaneous distalization of the first and second maxillary molars with the iPanda using the finite element (FE) method.
Materials and methods : Three-dimensional FE models of a maxillary arch with complete dentition, periodontal ligament, palatal and alveolar bone, and an iPanda were created. In the “en masse” model, the iPanda was connected to the first molar to distalize “en masse” the first and second molars with varying forces from 50 to 300gf. In the simultaneous model, the iPanda was connected to the first molar with a distalization force of 100gf plus a 50gf buccal open coil spring inserted between the first and second molars. The stress distribution and displacement patterns were analyzed.
Results : In the “en masse” model, the stress distribution was mostly concentrated at the furcation and along the distal surface in all roots of the first molar (90.2%) while only 9.6% of stress being transferred to the roots of the second molar. Moreover, a great tendency for distobuccal crown tipping of the first molars and a minimal amount of distalization of the second molars was shown. In contrast, in the simultaneous model, a better stress distribution at the furcation and along the distal surface in all roots of the first molar (60.2%) and second molars (35.0%) was observed. Moreover, a reduced tendency for distobuccal crown tipping of the first molars and a greater amount of distalization for both the first and second molars was observed.
Conclusions : “En masse” distalization resulted in increased force levels with undesirable distobuccal crown tipping of the first molars with a minimal distalization. In contrast, the simultaneous distalization resulted in effective stress distribution with reduced force levels and a larger amount of distalization for both the first and second molars.

P-019

Biomechanical Analysis for Total Mesialization of the Maxillary Dentition: A Finite Element Study

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Objectives : The purpose of this study was to analyze and clarify tooth movement during mesialization of the whole maxillary dentition with various force angulations (FAs).
Material and Methods : A finite element method was used to simulate the long-term orthodontic movement of the maxillary dentition by accumulating the initial displacement of teeth produced by elastic deformation of the periodontal ligament. A mesial force of 3 N was applied to the maxillary second molar at 5 different FAs (30 , 15 , 0 , 15 , and 30) to the occlusal plane.
Results : At an FA of 28 , the line of action of the force passed through the center of resistance of the maxillary whole dentition. With all FAs, the central incisors and molars tipped labially and mesially, respectively. The tipping angles gradually decreased as the FAs shifted from 30 to 30 . The molars tipped lingually with FAs of 30 and 15 , whereas they tipped buccally with FAs of 0 , 15 , and 30 . The molars tended to rotate mesiolingually more as the angle of force increased toward an FA of 30 . The occlusal plane rotated counterclockwise with FAs of 30 , 15 , and 0 , whereas it rotated clockwise with FAs of 15 and 30 . With an FA of 30 , buccal tipping and mesiolingual rotation of the molars, and the change in the occlusal plane angle decreased when the transpalatal arch (TPA) was fixed to the first molars and decreased, even more when the TPA was fixed to the second molars rather than the first molars, when a thicker TPA was used, and when the TPA was fixed to both molars rather than a single molar.
Conclusion : There was a correlation between tooth movement during mesialization of the whole maxillary dentition and the angle at which the force was applied.

P-020

Influence of changing various parameters in mini implant-assisted rapid palatal expansion on dentoskeletal expansion patterns

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Objectives : The purpose of this study was to analyze the effects of the number, position, and length of mini implants used in a bone-borne RPE, and that of the design and positional changes of the expander, on maxillary expansion using the three-dimensionsal finite element method.
Material and Methods : Kee's Bone Expander was located at the midpalatal suture and was centered on the contact between the second premolar and the first molar. For mini implants, a thickness of 1.8 mm and lengths of 6, 8, 10, and 16 mm were used. The length of the hook was changed depending on the 3D model conditions. A finite element model was constructed from a computed tomography image of an adult dry skull and the distribution of von Mises stress and displacement were analyzed.
Results : Both anterior and posterior placement of mini implants were the most advantageous in terms of achieving maxillary expansion. Posterior placement of miniscrew showed clockwise rotation of the maxilla while anterior placement of miniscrew showed counterclockwise rotation. In case of the mini implant length, similar stress distributions were observed in all groups. As the mini implant length increased, greater intrusion was observed in the anterior teeth than in the posterior teeth. Expander in anterior direction showed greater changes in overall transverse displacement and increased clockwise rotation of the maxilla whereas expander in posterior direction showed an overall total intrusion of the maxilla. The effect of expander hook length appears to have non-linear relationship between stress distribution.
Conclusion : Anteroposterior placement of mini implants was the most advantageous in terms of achieving maxillary expansion. Although the mini implant or hook length and anteroposterior positional changes of the expander did not significantly affect maxillary expansion, they affected vertical positional changes of the maxilla and caused three dimensional movements of the maxilla.

P-021

Hooke's law on the deflection of orthodontic wires according to changes in diameter and length

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Objectives : The goal of this study was to verify propositions that are used to explain changes in intensity, stiffness, and range of orthodontic wires based on their different lengths and thicknesses, as the applicability of such propositions on orthodontic wires, provided by the deflection curve equation based on elastic theory, has never been proved despite being regarded as facts explained in textbooks of orthodontics.
Material and Methods : The following propositions based on Hooke's law were tested. Proposition I: Strength of wire gets raised as a third power of the ratio of the diameter of two cross-sections, while stiffness varies as a fourth power of the ratios, and range changes inversely. Proposition II: Strength of wire varies inversely with length, while stiffness changes inversely to the third power when compared to the length and range varies as a second power function. Deflections of multiple lengths and diameters of wire were measured with multiple loads under different fixing conditions, different types of wires, different lengths, and difference forces of pressure applied.
Results : All recorded values differed from the expected theoretical values provided by both propositions under Hooke's law.
Conclusion : This study revealed that the clinical usage of orthodontic wires does not satisfy such conditions, and that the deflection of orthodontic wires within realms of clinical usage does not follow Hooke's law. Every result of experiment testing deflection of orthodontic wire indicated drastic differences from the expected results, proving that deflection curve equation based on elastic theory can not be applied for orthodontic wires.

P-022

New Bone Formation after Orthodontic Extraction of Impacted Mandibular Third Molars with Smart Springs

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Purpose : To compare the amount of alveolar bone gain on the distal of the iM7 with the orthodontic extraction (OE) of the iM8s with the Smart Springs and conventional methods.
Materials and methods : In this prospective clinical study, 40 patients 18-30 years old with iM8s were enrolled and divided into 2 groups per patient choice. In the OE group (n = 20), Smart Springs anchored to miniscrews were applied to upright the iM8s before OE. In the control group (n = 20), patients had their iM8s surgically removed with conventional methods. Panoramic images at the time of surgical removal (T0) and 6 months follow-up (T1) postoperatively were acquired. The total amount of alveolar bone gain distal to the iM7s was measured and analyzed statistically.
Results : All teeth were removed without complications. A significant increase (2 times) in the alveolar bone gain on the distal of the iM7s in the OE group (3.6 ± 1.5 mm) compared to the control group (1.6 ± 1.9 mm) was observed. p
Conclusions : The use of Smart Springs for OE of the iM8s reduces the risks of the periodontal defect and induces the new alveolar bone formation distal to the iM7s.

P-023

Tissue-specific Biomarkers in Gingival Crevicular Fluid Are Correlated with External Root Resorption Under Orthodontic Movement

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Objectives : This study investigated the association of changes in cementum protein-1 (CEMP-1), dentine phosphoprotein (DPP), and c-terminal cross-linked telopeptide of type I collagen (CTX-I) levels in human gingival crevicular fluid (GCF) under constant load with external root resorption volume and amount of tooth movement.
Material and Methods : In total, 11 healthy adult patients (mean age, 23.5 years [range, 18.3–37.7]; four men and seven women) were enrolled. GCF samples were obtained from premolars at T0, T1 (1 day), T2 (1 week), T3 (2 weeks), T4 (4 weeks), and T5 (8 weeks) under constant 100-gm buccal tipping force. Opposite premolars were used as controls. Teeth were extracted at T5, followed by quantification of external root resorption volume and histological analysis.
Results : In the test group, T5/T0 ratios of CEMP-1 and DPP levels, differential CEMP-1 levels between T5 and T0, and differential DPP levels between T2 and T0 corelated positively with root resorption volume ($r = 0.734$, 0.730, 0.627, and 0.612, respectively, all $p<0.05$). CEMP-1 levels at T0 and T3 correlated negatively with root resorption volume ($r = -0.603$ and -0.706; all $p<0.05$). CTX-I levels at T5 correlated positively with the amount of tooth movement ($r = 0.848$, $p < 0.01$).
Conclusion : Alterations in CEMP-1 and DPP levels in human GCF at specific timepoints during orthodontic treatment may be associated with different degrees of external root resorption.

P-024

The Experimental Orthodontic Tooth Movement in Ovariectomized Rat Model : a Pilot Study

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Objectives : This study aims to investigate the effect of osteoporosis on orthodontic tooth movement (OTM) in ovariectomized rats.
Material and Methods : The Sprague-Dawley rats were divided into two groups, according to whether or not ovariectomy was performed. The control groups (group A) were subjected to force of 50g at 12 weeks. Bilateral ovariectomies were performed on the ovariectomy groups (Group B). And Eight weeks after ovariectomy, the orthodontic force using a power chains were placed between the maxillary right first molar and mini-screw as an anchor system. Both groups were sacrificed each experimental period on days 5, 7, 10, 14 and 21 after orthodontic force, and only the 21day relapsed from 14day for 1week. Each rat was subjected to micro-computed tomography (uCT), and the distance of OTM was measured by a uCT and a electronic caliper. The histologic analysis were assessed through hematoxylin and eosin (H&E) staining, tartrate-resistant acid phosphatase (TRAP) staining and immunohistochemestry (IHC) analysis.
Results : The distance of OTM was the highest and The TRAP-positive cells, the positive expression levels of receptor activator of nuclear factor-kappa β (RANK) ligand were the strongest in the ovariectomy group. In contrast, the positive expression levels of osteoprotegerin (OPG) was higher in control group. The relapse distance for the ovariectomy group were higher.
Conclusion : These results indicate that ovariectomized rats can affect the weight, OTM and TRAP-positive cells and the level of RANK ligand, OPG in rats.

P-025

Orthodontic treatment with surgical extrusion of an ankylosed upper first molar

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Introduction : Ankylosis is a cellular change in periodontal ligament that results in forming bony bridge between cementum and alveolar bone. Ankylosis in permanent teeth has a low incidence, and it is difficult to determine exact etiology. Most of reported cases for treatment of ankylosed teeth were cases of the maxillary central incisors, and there are few cases of maxillary first molars. The positional and anatomical features of ankylosed maxillary first molars affect the treatment plan, but a clear protocol for ankylosed molar is not presented. Therefore, through this case study, I intend to present and discuss the treatment protocol from the diagnosis of ankylosis to surgical extrusion.
Case Summary : An 11-year-old female patient had the chief complaint of delayed eruption of the right maxillary first molar. Ankylosis of #16 was suspected through clinical and radiographic findings including CBCT. Orthodontic traction of #16 with a mini screw was unsuccessful, and #16 was finally diagnosed as ankylosis. After that, orthodontic traction with surgical luxation was performed, but it failed to tract an ankylosed molar. Finally, surgical extrusion was performed. As a result, #16 were arranged at the occlusal level harmoniously with the surrounding dentition.
Conclusion : Surgical approach removes the bony bridge between cementum and alveolar bone, allowing ankylosed teeth to temporarily respond to orthodontic force. However, it is not desirable to select surgical procedures for an ankylosed molar because there is a risk of irreversible damage, such as fractures of alveolar bone and root during surgical procedures. Therefore, a surgical extursion should be carried out after orthodontic traction is first attempted and ankylosis is clinically confirmed to be undrawn. Even within surgical procedures, traction after less invasive surgical occlusion is prioritized.

P-026

A Case Report of Class II Patients with Mixed Dentition Treated by Myofunctional Appliance

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Introduction : In growing patients, it is often found that the skeletal Cl II discrepancy causes functional problems of the oromuscular system, further exacerbating the malocclusion. Therefore, for the successful treatment of the Cl II malocclusion in the mixed dentition, the myofunction must be considered. The myofunctional appliance accompanied by myofunctional exercise induces lip sealing to prevent the protrusion of the maxilla and maxillary incisors, and expands the maxillary arch. In addition, it helps to solve the severe COS by inducing the anterior growth of the mandible and the proper overjet, overbite relationship.
Case Summary : First case is a 10-year-old girl patient with protrusion of the maxillary incisors, square shaped maxilla and short mandible She was being treated using mufunctional appliance. Second case is an eight-year-old girl. She showed mouth breathing due to her short upper lip and incisor protrusion. treated with inducing lip-shilling using myofunctional therapy appliance, mandibluar COS and maxillary incisor protrusion were reduced through bite practice. The third case is a 10-year-old boy who treated a Cl II malocclusion with high canine and deepbite using myofuctional appliance. Forth case is 8 years old girl with Class II molar relationship, narrow maxilla and protrusive incisor. she was treated using myofunctional appliance, as result, forward growth of mandible and correction of dental discrepancy were achieved.
Conclusion : Myofuctional appliance with myofunctional exercise for Cl II patients with mixed dentition can be a good treatment to inhibit the growth of the maxilla and help the growth of the mandible by expanding the maxillary arch.

P-027

Use of a Myofunctional Device for Maintenance after the Orthodontic Treatment in Mixed Dentition

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Introduction : Young patients with a class III skeletal malocclusion with anterior crossbite or a class II skeletal malocclusion with a large horizontal overbite came to orthodontic clinic. In such cases, growth modification treatments were performed using devices such as a facemask or headgear. The purpose of these growth modification treatments is primarily to help patients achieve good growth balance. However, sometimes even if growth control is not completely achieved, treatment is performed to improve the occlusion of the teeth. If the occlusal relationship is improved to some extent through the 1st treatment (growth modification treatment), fixed orthodontic treatment can be performed more easily. After the 1st orthodontic treatment, orthodontists may have to wait a long time before starting the 2nd orthodontic treatment (fixed orthodontic treatment). In such cases, orthodontists often have a period of simple observation rather than active orthodontic treatment. However, for fear that the effect of primary orthodontic treatment for growth control will disappear, orthodontists look to see if there is anything they can do for the patients.
Case Summary : This presentation reports two cases of effective maintenance using myofunctional devices after growth orthodontic treatment for Class II malocclusion with severe overjet and Class III malocclusion with anterior cossbite.
Conclusion : After the 1st orthodontic treatment were completed in patients with mixed dentition, stable occlusion was observed using myofunctional devices within the maintenance period.

P-028

Skeletal Class III Camouflage Treatment with Molar Mesialization related to Horizontally Impacted Third Molar

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Introduction : With the development of the skeletal anchorages, challenging cases such as protraction of mandibular molars or mesial and distal movement of total dentition have been reported.
In the case, the patient had Skeletal Class III malocclusion with horizontally impacted third molar overlapped root of second molar. Using mini-screw and mini-plate as skeletal anchorages, mesial movement of the mandibular right second molar and distal movement of mandibular left dentition were successfully performed.
Case Summary : 23Y / Male
Chief complaint : Mesialization of mandibular molars
The 23-years-old male complained for mesialization of mandibular molars. Facial analysis showed chin prominence and lip retrusion. In panoramic radiograph, the mandibular right third molar was horizontally impacted and closed to inferior alveolar nerve and second molar. In oral examination, the mandibular right second molar was distally angulated. The maxillary and mandibular incisors were lingually inclined with anterior crowding. Class I canine and molar key on right and Class III canine and molar key on left side were observed. Additionally, a shallow overjet was noticed.
In this case, to move the mandibular right molar mesially, the mandibular right second premolar was extracted and a mini-screw was placed between the right canine and first premolar. In addition, a mini-plate was implanted on left side of mandible to correct the midline shift and establish an appropriate molar relationship.
Conclusion : In this case, with the proper use of a skeletal anchorages, the mesial movement of the mandibular molars and the distalization of mandibular left dentition were achieved. Besides, it was possible to obtain a successful treatment result that would be helpful in surgical extraction of the severely impacted third molar as an interdisciplinary orthodontic treatment.

P-029

Long Term Prognosis of a Maxillary Premolar Replacing a Mandibular Molar through Autotransplantation

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Introduction : This case report illustrates the outcome and long term prognosis after autotransplantation of a mature maxillary premolar as a missing mandibular molar as a part of comprehensive orthodontic treatment.
Case Summary : A 37-year-old adult indicated a skeletal Class II Division 2 posttraumatic dentition with multiple tooth fractures, consequential restorations including dental implants of the upper right premolars, and anterior crowding. In addition, the lower first molar was diagnosed hopeless due to periodontal problems. To improve the overall occlusion, maxillary right canine and left first premolar were extracted, but the extracted maxillary premolar was autotransplanted to replace the hopeless mandibular first molar. A multidisciplinary approach including autotransplantation and orthodontic treatment provided a satisfactory outcome. The transplant was functional and maintained a normal bone level throughout the 10-year follow up period. Clinical examination showed normal physiologic movement without any signs of ankylosis and root resorption of the transplanted tooth.
Conclusion : Autotransplantation of a mature maxillary premolar to a mandibular molar site is a viable treatment option showing successful results and favorable long term prognosis. The selection of a functional donor tooth, adequate surgical procedures, and timely application of orthodontic movement may have positively contributed to the favorable treatment result and prognosis in the long term.

P-030

Improvement of the Smile Esthetics in a Middle-aged Patient with a Missing Lower Second Molar

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Introduction : There are several treatment options for the management of patients with a missing mandibular second molar such as single-tooth implant or protraction of a posterior third molar. Size, shape, periodontal tissue and root length of the third molar should be taken into consideration to select the appropriate treatment plan. This case report illustrates a successful orthodontic outcome of a middle-aged skeletal Class II malocclusion with un-esthetic smile and a hopeless lower second molar.
Case Summary : A 40-year-old female indicated skeletal Class II with protrusion with hopeless lower right second molar (#47). She also presented a gummy smile along with upper anterior crowding with size and shape differences between the central incisors and midline deviation. The overall Class II malocclusion and protrusion were corrected with total arch distalization and full arch impaction in the maxillary arch and total arch distalization in the mandible along with protraction of the right third molar (#48) to substitute for the missing second molar. Additional adjustment to level the gingival margin and reshaping of the left central incisor to correct the size and shape discrepancies between the maxillary central incisors provided favorable improvement of the smile esthetics as well.
Conclusion : Improvement the overall macro-esthetics as well as micro-esthetics and conservative treatment to substitute the third molar as a missing second molar provided satisfactory orthodontic treatment outcome in a middle-aged patient.

P-031

Treatment of a Patient with Peg Lateralis by Extraction of a Lower Incisor: 10-year Retention

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Introduction : The extraction of a lower incisor is one of the therapeutic alternatives in treating certain anomalies including tooth size discrepancy and moderate to severe crowding in the lower arch. In case of peg lateralis, in particular, extraction of a lower incisor may help avoiding additional prosthetic treatment of the peg-shaped lateral incisors. It also simplifies the orthodontic treatment mechanics which leads to reduced treatment time.
Case Summary : We report the case of a 25-year-old female patient who had a skeletal Class I malocclusion with peg-shaped maxillary lateral incisors, moderate crowding on lower anterior teeth, severe rotation on the lower second premolars, and Class I molar and canine key on both sides. We decided to extract the lower left central incisor to relieve crowding caused by upper and lower tooth size discrepancy. After orthodontic treatment, proper overjet, overbite, and occlusion were achieved. Long term usage of a fixed lingual retainer contributed to minimize relapse.
Conclusion : Extraction of a lower incisor can be a proper treatment option for some cases with peg lateralis and moderate lower anterior crowding. A skeletal Class I patient who corresponds to the condition was treated successfully by extracting a lower incisor and the results were stably maintained after 10 years.

P-032

Orthodontic Intrusion of Maxillary Molars for Achieving Inter-occlusal Clearance

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Introduction : This case showed the treatment of intrusion of the maxillary molars to acquire a prosthetic space in the mandibular molars. Maxillary molars were intruded and canine guidance was restored maintaining the vertical facial height. During the orthodontic treatment, close multidisciplinary care was preceded. As a result, we obtained an appropriate occlusion and the improvement of the prosthesis prognosis.
Case Summary : This case study was about a patient referred from the department of prosthodontics due to inter-occlusal clearance of the mandibular molars. At the start of the treatment, patient's cantilever of #34=36 and bridge of #44=46-47 were in severe wear state, and the opposing maxillary molars were extruded accordingly. The department of prosthodontics planned crown lengthening procedure and fixed prosthesis remake. However, due to continuous broken and fallen out of the temporary prosthesis, the maxillary molars should be intruded for adequate crown height.
First, leveling and alignment were performed on posterior region and then intermolar width was maintained using bonded type TPA. TADs were placed on the upper buccal side and maxillary molars were intruded. Posterior clearance was checked by the prosthodontist and occlusal canting was controlled with uniform occlusal contact during the treatment.
Conclusion : In this case, maxillary molars had been extruded due to the wear of the mandibular posterior prosthesis over a long period of time. Proper inter-occlusal clearance could be achieved through the intrusion of the maxillary molars, while maintaining the facial height. As a result, we could achieve proper prosthesis, oral hygiene management, and improvement of lifespan and good prognosis of prosthesis.

P-033

10-year Retention after Treatment of a Skeletal Class II with Lip Protrusion and Deep Bite

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Introduction : The first and one of the most important steps in orthodontic treatment is to make an accurate diagnosis and determine which mechanics to use and whether to include extractions, , especially if the patient is over the age of 40. In this case report, we describe a successful treatment of a skeletal Class II adult patient with lip protrusion and deep bite by extraction of maxillary first premolars.
Case Summary : A 41-year-old skeletal Class II female patient had protrusion and spacing on maxillary anterior teeth, large overjet and overbite, large curve of Spee in the lower arch, and lip protrusion. Maxillary first premolars were extracted and the space was closed accompanied by 2mm anchor loss on the posterior teeth. Three-piece intrusion arch was placed in the lower arch to relieve severe curve of Spee, which also worked as a molar uprighting spring on the posterior area. After orthodontic treatment, proper overjet, overbite, and favorable occlusion was achieved, and lip profile was improved. The results have been stable throughout the 10-year follow up period.
Conclusion : A skeletal Class II patient with lip protrusion and large overjet, overbite was treated successfully with extraction of maxillary first premolars and three-piece intrusion arch in the mandible, and the treatment results remained stable.

P-034

Treatment of a Skeletal Class II with Fused Maxillary Central Incisor: 5-year Follow Up

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Introduction : A supernumerary tooth fused to a normal tooth often causes malocclusion and esthetic problems because of malformation and large crown. This requires treatment such as sectioning and extraction of supernumerary tooth, modification of crown shape and restoration, or extraction, and endodontic treatment is often required as part of the procedure. In this case report, we describe the successful treatment of a skeletal Class II adolescent patient with fused maxillary central incisor to a supernumerary tooth by extracting the adjacent lateral incisor and prosthetic treatment on the fused teeth.
Case Summary : A 12-year-old skeletal Class II patient had a convex profile and fused maxillary right central incisor with a supernumerary tooth, and palatally erupted lateral incisor due to space deficiency. Rapid maxillary expander was placed on his upper arch and after expansion, high pull headgear and Class II monoblock was used to improve skeletal relationship. After 23 months of orthopedic treatment, first premolars and maxillary right lateral incisor were extracted, and TADs were inserted in each quadrant to close the space. After orthodontic treatment, the fused incisors were restored with PFM splinted crowns without endodontic treatment. The results were well maintained during the 5-year retention period.
Conclusion : A skeletal Class II patient with fused maxillary central incisor could be successfully treated by orthopedic treatment during growth, and by extraction of first premolars and lateral incisor next to the fused supernumerary tooth followed by restoration of the fused teeth after growth completion. The results were stably maintained after 5 years.

P-035

8-year Retention after Treatment of Congenitally Missing Upper Second Premolars and Lower First Premolars

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Introduction : Dentists often encounter situations with missing upper and lower premolars. The orthodontist must make the proper decision regarding management of missing premolars. It is necessary to plan for the edentulous space. It could be a single tooth implant, or bridge restoration. Another alternative treatment option is to close the space. In this case report, we will show successful treatment of a case with congenitally missing upper second premolars and lower first premolars. Treatment results were well maintained during the 8-year retention period
Case Summary : We report the case of a 16-year-old male with skeletal Class I malocclusion, congenitally missing upper second premolars and lower first premolars, buccal crossbite on the left posterior side, dental midline shift and Peg lateralis. We decided to close the lower edentulous space and make space distal to the lateral incisors. Resin build up was then performed on the space. After orthodontic treatment, proper overjet, overbite and occlusion were achieved. The occlusion remained stable after 8 years with lingual fixed retainers and removable circumferential retainers on both arches.
Conclusion : Favorable occlusion and profile was established by closing of space for a patient with congenitally upper and lower premolars. The treatment results remained stable during the 20-year follow up period.

P-036

Substitution of Congenitally Missing Mandibular Incisors and Maxillary Peg Lateralis with Canines: 5-year Retention

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Introduction : There are several treatment options for the management of patients with missing mandibular lateral incisors such as canine substitution, a tooth-supported restoration or a single-tooth implant. Facial profile, tooth size relationship, and size and shape of the canine should be taken into consideration to select the appropriate treatment plan. In this case report, we describe the successful treatment outcome and 5-year follow up of substitution of congenitally missing mandibular lateral incisors and maxillary peg lateralis with canines.
Case Summary : We report the case of a 20-year-old female patient with skeletal Class I, congenitally missing mandibular lateral incisors, maxillary peg lateralis, upper anterior crowding, and a Class I molar and canine relationship. Peg-shaped maxillary lateral incisors were extracted and substituted with canines. Also missing mandibular lateral incisors were successfully substituted with canines by means of interproximal reduction and incisal edge reshaping on canines. After orthodontic treatment, the final occlusion was favorable and an esthetic facial profile was achieved. The results have been stable throughout the 5-year follow up period.
Conclusion : A skeletal Class I patient with missing mandibular lateral incisors and maxillary peg lateralis was treated successfully with extraction of maxillary lateral incisors and canine substitution and the treatment results remained stable after 5-year retention period.

P-037

Camouflage Treatment of a Skeletal Class III with Facial Asymmetry: 7-year Follow Up

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Introduction : Treatment options in adult patients with skeletal Class III and facial asymmetry are surgery, extraction, or distalization of the lower dentition. Distalization of the lower dentition can be considered when skeletal discrepancy is mild and the there is sufficient space between mandibular second molar root and lingual cortex of the mandibular body. In this case report, we describe the successful camouflage treatment of skeletal Class III with facial asymmetry by using RME and distalization of the lower dentition.
Case Summary : We report the case of a 18-year-old male with mild skeletal Class III, facial asymmetry and anterior crossbite. He also had a relatively narrow upper arch. Before distalization of the lower dentition, arch width discrepancy was corrected by rapid maxillary expander and after consolidation, transpalatal arch was used to maintain arch width. Distalization of the lower dentition was performed to establish a proper molar and canine key relationship. The final occlusion was favorable and an esthetic facial profile was achieved. The results have been maintained stable throughout the 7 years of follow-up period.
Conclusion : A patient with skeletal Class III and facial asymmetry could be successfully treated by using by using RME and distalization of the lower dentition and the results maintained stable.

P-038

Hemimandibular hyperplasia treatment with condylectomy and orthodontic camouflage treatment using miniplate

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Introduction : The present case report describes the treatment of a patient with hemimandibular hyperplasia(HH) with a low condylectomy followed by intrusion of the maxillary posterior teeth with a miniplate on the affected side and extrusion of the other posterior teeth without additional orthognathic surgery.
Case Summary : A 13-year-old growing female patient presented with hemimandibular hyperplasia of the right side, Class III hypodivergent skeletal pattern, and severe facial asymmetry. Corrective surgery was deferred until her growth had been completed. When the patient was 16 years old, a low condylectomy was performed on the hyperplastic side of her mandible to prevent its progressive condylar hyperplasia, while simultaneous orthodontic camouflage treatment was performed with the intrusion of the maxillary right posterior teeth using temporary skeletal anchorage devices without additional orthognathic surgery. A low condylectomy caused anterior and lateral open bite after the downward and backward movement of the chin, which improved Class III appearance. The intrusion of the maxillary right posterior teeth followed by compensating extrusion of the mandibular posterior teeth contributed to improve the patient's facial asymmetry with correction of the transverse occlusal plane
and lip canting. After 30 months of treatment, an acceptable esthetic outcome and functional occlusion were achieved. The treatment results were well maintained for 1-year retention.
Conclusion : An HH with Class III malocclusion was successfully treated with orthodontic camouflage treatment using a miniplate and low condylectomy without additional surgery. The outcome was good esthetic and functional results.

P-039

Treatment of a malocclusion with peg lateralis by extraction of a lower incisor: 4-year retention

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Introduction : Patients with peg lateralis are often treated by gaining space mesial and distally to the lateral incisor, followed by prosthodontic treatment on peg lateralis. On the other hand, extraction of a lower anterior tooth is recommended in some cases when the patient refuses prosthetic treatment. This report demonstrates the successful treatment of a Class I patient with anterior crowding, peg lateralis on both upper lateral incisors, treated by extracting a lower incisor. Treatment results were well maintained up to the 4-year retention period.
Case Summary : We report the case of a 22-year-old male presented with skeletal Class I malocclusion, anterior crowding, peg lateralis on both upper lateral incisors, and Class II molar and canine key on the left side. According to sum of incisors and Bolton analysis, we decided to extract the lower right central incisor for crowding relief to gain proper occlusion. After orthodontic treatment, proper overjet, overbite and occlusion were achieved. The occlusion remained stable after 4 years with fixed retainers and removable circumferential retainers on both arches.
Conclusion : Treatment plans should be established based on the individual patient's circumstances. In this case, treatment by extraction of a lower incisor resulted in proper outcomes, and by using fixed retainers and removable circumferential retainers, the outcome remained stable after 4-year retention. It could be desirable for orthodontists to consider extraction of a lower incisor in the case of peg lateralis for proper treatment results and retentions.

P-040

10-year retention after treatment of skeletal Class II with anterior crowding and deep bite

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Introduction : This report demonstrates the successful treatment of a skeletal and dental Class II patient with severe crowding in the upper and lower arch, and deep bite. Orthodontic treatment was carried out following extraction of upper and lower first premolars. After achieving a suitable outcome, treatment was well maintained up to the 10-year retention period.
Case Summary : We report the case of a 27-year-old female presented with skeletal Class II malocclusion, lip protrusion, class II molar and canine key, severe anterior crowding, large overjet and deep bite. We decided to extract upper and lower first premolars in order to improve the facial profile and achieve a good occlusion. Inter-radicular TADs on upper arch were used to reinforce upper molar anchorage and maximize the amount of anterior teeth retraction. After orthodontic treatment, proper overjet, overbite and occlusion were achieved. Moreover, the occlusion remained stable after 10 years with fixed retainers and removable circumferential retainers on both arches.
Conclusion : Treatment of skeletal Class II patients with severe crowding is often accompanied by extraction of first premolars. In this case, TADs were used to achieve maximum anchorage. By using both fixed retainers and removable circumferential retainers, the treatment outcome maintained successfully for 10 years as proper occlusion and esthetics.

P-041

Extraction of a lower incisor in case of severe crowding: 12-year follow up

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Introduction : Extraction of teeth is often considered to relieve malocclusion with severe crowding, and we need to make a proper decision on which teeth to extract. This case report demonstrates the successful treatment of a skeletal Class I patient with severe crowding in the lower arch, treated by extraction of a lower incisor. Treatment results were well maintained up to the 12-year retention period.
Case Summary : We report the case of a 19-year-old male who was presented with skeletal Class I malocclusion, lower anterior crowding with lack of space for almost one lower incisor, and deep bite. Since the lower left central incisor was labially positioned and showed moderate gingival recession, we decided to extract the incisor to relieve crowding on lower teeth. Stripping on the upper anterior teeth was performed to gain proper occlusion relationship. After the orthodontic treatment, proper overjet, overbite and occlusion were achieved. The occlusion and esthetics remained stable after 12 years with fixed retainers and removable circumferential retainers on upper and lower arches.
Conclusion : To relieve crowding, extraction of a lower incisor may be acceptable in some cases for function, esthetics and stability. By using fixed retainers and removable circumferential retainers, the outcome remained stable throughout the long term period.

P-042

Treatment of lip protrusion with extraction of peg lateralis: 20-year retention

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Introduction : Treating malocclusion with peg lateralis, the majority of treatments are planned to gain space on anterior teeth, including prosthodontic treatment on peg lateralis. However, peg lateralis were extracted instead of maxillary first premolar and substituted with maxillary canines in this case in order to improve protrusive profile. Tooth size relationship, and size and shape of the canine should be taken into consideration to substitute lateral incisor with canine. In this case report we describe the successful treatment and 20-year follow up of substitution of maxillary lateral incisors with canines.
Case Summary : We report the case of a 31-year-old woman with skeletal Class II, deep bite, peg lateralis, missing mandibular first molars, upper lip protrusion, Class II molar relationship and lower anterior crowding. Peg lateralis were extracted and maxillary central incisors were intruded by 3-piece intrusion arch wire. Maxillary lateral incisors were successfully substituted with canines by means of interproximal reduction and incisal edge reshaping. Maxillary canines were successfully substituted with first premolars also and group function was established through occlusal adjustment. The final occlusion was favorable and an esthetic facial profile was achieved. The occlusion and periodontal condition have been stable throughout the 20-year follow up period.
Conclusion : A skeletal Class II patient with deep bite, peg lateralis and upper lip protrusion was treated successfully with extraction of peg lateralis and canine substitution. The treatment results remained stable during the 20-year follow up period.

P-043

Orthodontic Treatment of a Moderate Crowding Problem in the Early Mixed Dentition

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Introduction : It is well known that there are 3 ways to manage crowding problems in an adolescent: extraction, interproximal reduction, and expansion (both laterally and posteriorly). Patients with severe crowding in the mixed dentition are often best treated with a serial extraction protocol. Interproximal reduction can be used effectively to resolve mild-to-moderate crowding problems, but we use this procedure primarily during phase II treatment. For lateral expansion during mixed dentition, removable acrylic appliances with expansion screws such as the Schwarz appliance, have been widely used. Although expansion of the mandible has theoretically never been successful, several studies have reported good clinical results with the technique. This case report describes the treatment of a 6-year-old male patient with a moderate crowding problem.
Case Summary : A 6-year-old male patient was described who had a convex profile, hyperdivergent growth pattern, skeletal Class II malocclusion, diastema on the lower dentition, and a crowding problem of the lower incisors. His chief complaint was a diastema on the lower dentition and a not enough space for the lower lateral incisors. Slow expansion with removable acrylic appliances on the maxillary and mandibular dental arches was performed to resolve a space problem. As the lower incisors were erupted, fixed appliances were placed to align them. The orthodontic treatment took approximately 33 months including a waiting time for the incisors eruption. The patient was satisfied with treatment outcomes.
Conclusion : For a child patient with a moderate crowding problem, removable acrylic expansion appliances followed by fixed appliances could be effective in the early mixed dentition.

P-044

Case Report of Gummy Smile Patient Using Miniscrew between Upper Central Incisors

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Introduction : Gummy smile causes aesthetic problems. The orthodontic treatment of gummy smile patient with anterior deep bite requires an Intrusion of upper incisors. We report a gummy smile case using a miniscrew between upper central incisors.
Case Summary : We report the case of a 27-year-old woman who had a skeletal Class II malocclusion, linguoversion of upper incisors, crowding of lower teeth, protrusion of upper lip, anterior deep bite and gummy smile. To intrude upper incisors, we inserted a miniscrew between upper central incisors and applied light force to avoid a root resorption.
After the intrusion of upper incisors, anterior deep bite was improved and Intrusion force from the screw made the upper incisors flared. Too many intrusion of upper incisors could make smile line flat, so periodic checks of vertical position of upper incisors are required.
After leveling and alignment of upper and lower teeth, the profile was evaluated with lateral cephalometric radiograph and extraoral photos. To treat a protrusion of upper lip and large overjet, two upper first premolars were extracted. After space closure, the patient had a good profile and a normal smile line. The overjet & overbite was normal and the molar key was class II.
Conclusion : To correct the gummy smile case with anterior deep bite, it needs an Intrusion of upper incisors. A miniscrew between upper central incisors could be a good solution. But light intrusion force is essential and excessive intrusion that exacerbates the smile line should be avoided.

P-045

6-year retention after orthopedic and camouflage treatment of skeletal Class III with severe space deficiency

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Introduction : Facemask treatment is an effective treatment modality for skeletal Cl III patients, but dental side effects like maxillary anterior crowding are often inevitable due to the forward movement of posterior teeth. Basically, extraction of teeth in orthodontic treatment should be considered near to the completion of growth but when severe crowding is expected, early extraction may be beneficial. In this case report, we describe the successful treatment and long term follow up of facemask treatment with early extraction of both upper first premolars.
Case Summary : A 11-year-old skeletal Class III female patient had severe eruption space deficiency of both upper canines and second premolars. She wore facemask combined with rapid maxillary expander for 1 year. After improvement of the skeletal pattern, the rapid maxillary expander was removed both maxillary first premolars were extracted. Re-analysis for phase II treatment was performed when she was 16-year old. At phase II period, both mandibular second premolars were extracted additionally. After 15 months of treatment, Class I occlusion and good facial profile were obtained. After 6years of retention, occlusion was maintained but mild lower midline deviation was observed.
Conclusion : A skeletal Class III patient with space deficiency on both maxillary canines and second premolars could be successfully treated by facemask treatment and early extraction of both maxillary first premolars. The results have been stable throughout the 6-year follow up period.

P-046

Profile Changes in Young Adult Patients with Class II Malocclusion during Retention Period

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Introduction : For decades, there has been an increased demand for facial esthetics. There is also a high demand for esthetic facial profiles in orthodontic area. It is known that South Koreans prefer straight profiles to convex or concave profiles. So, we orthodontists take facial esthetics into account when establishing orthodontic treatment plans. Facial growth correlates with the physical growth, so it is generally known that facial growth would stop when physical growth completed. But some studies have shown that small but continuous facial growth may occur in adulthood. This case report describes 2 cases of showing profile changes in retention period in Class II young adult patients.
Case Summary : A 16-year-old girl and a 15-year-old boy had straight profile with crowding and Class II malocclusion. Orthodontic treatment with premolar extraction had performed and finished at 19 and 18 years of ages when the patients were at cervical vertebra maturation stage of 6. Favorable facial esthetic and functional occlusion were achieved after treatment. During the retention period, increase in mandibular length and SNB angle was observed and soft tissue thickness also increased in nose and chin area. Therefore, their upper and lower lips were in more retruded position relative to the esthetic line at retention period than after treatment.
Conclusion : It is difficult to assess termination of facial growth by chronological age, or cervical vertebrae maturation stages. Profile changes continued in young adult patients by continued mandibular growth, adaptive response of the condyle, nasal growth and changes in chin prominence. It is important to take account of the possible profile changes in retention period when establishing treatment plans.

P-047

Treatment with segmental osteotomy of ankylosed upper incisor: 4-year retention

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Introduction : Ankylosis is abnormal adhesion of alveolar bone to dentin or cementum. It is a common phenomenon after trauma. When an anterior tooth becomes ankylosed during the growth period, it results in infraocclusion and causes esthetic issues. In some cases, orthodontic movement combined with surgical luxation might be required. However, if the ankylosed tooth does not respond to orthodontic force, additional surgical procedures such as segmental osteotomy or alveolar bone distraction osteogenesis are needed to correct their positions. When sufficient periodontal tissue surrounds the ankylosed tooth, a segmental osteotomy can be carried out.
Case Summary : We report the case of an 18-year-old male presented with skeletal Class I malocclusion, spacing of lower anterior area, protrusive lower lips and deep bite. Upper right central incisor and lateral incisor were in infraocclusion and gingival level discrepancy was present which lead to the suspection of ankylosis. Due to transverse discrepancy we decided to do maxillary expansion with transpalatal arch and use canine expansion springs on both canines. Anterior space closure in the mandible was initiated after completion of maxillary expansion. The final step was to perform segmental osteotomy on the upper right central incisor in order to relocate the tooth into proper position. After treatment, proper overjet, overbite and occlusion were achieved. The periodontal condition in the surgical site was also favorable. The occlusion remained stable and open bite did not relapse after 4 years with fixed retainers and removable circumferential retainers on both arches.
Conclusion : This case report describes the treatment of an 18-year old male with ankylosed maxillary central incisor that was noticeably in infraocclusion. We performed a segmental osteotomy to align and level the ankylosed tooth. The dento-osseous segment was successfully repositioned with satisfactory periodontal results.

P-048

A Surgico-orthodontic Case Report of Skeletal Class III Patient with Unilateral Condylar Hyperplasia

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Introduction : Unilateral condylar hyperplasia is a rare malformation of non-neoplastic origin involving size and morphology of one of mandibular condyles. The enlargement of condyle results in facial asymmetry, mandibular deviation, malocclusion and articular dysfunction. It causes subsequent functional and aesthetic discomfort. Condylectomy could be the treatment for unilateral condylar hyperplasia of the mandible and severe facial asymmetry. The objective of this report is to present case of Skeletal Class III patient with unilateral condylar hyperplasia who underwent condylectomy and subsequent orthodontic treatment combined with orthognathic surgery.
Case Summary : A 18-year-old man presented with the chief complaint of mandible protrusion and facial asymmetry. Clinical and radiographic examinations revealed skeletal Class III with left unilateral condylar hyperplasia. He had prognathic mandible and severe maxillary canting with mandibular deviation related with unilateral condylar hyperplasia. He had dental Class III molar relation, general anterior & posterior openbite and anterior crossbite. The patient was treated with condylectomy and after one year, orthodontic treatment and orthoganathic surgery were performed. Bone remodeling occurred in the left condyle after condylectomy and left ramus height was slightly decreased. There was no condylar regrowth after condylectomy. This case ended up with good occlusion and relieved facial asymmetry . One year follow up showed favorable occlusion without facial asymmetry.
Conclusion : Good occlusion and relieved facial asymmetry could be achieved by orthodontic treatment and orthognathic surgery with condylectomy in case of Skeletal Class III patient with unilateral condylar hyperplasia.

P-049

Non-Surgical Treatment of Skeletal Class II Adult Patient with Osteoarthritis of Temporomandibular Joint

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Introduction : Degenarative disease of temporomandibular joint was found mostly in young women. Orthodontic treatment of patients with temporomandibular disorder is one of the challenging for dothodontists because of patient's unstable condylar position. Therefore, orthodontists need to stabilize patient's condylar position before active tooth movement and check the sign and symptom of TMD periodically during orthodontic treatment.
Orthodontic treatment of severe skeletal Class II adult often requires repositioning of both the maxilla and mandible through orthognathic surgery. However, non-surgical treatment is required if patients don't want to have surgery. Although there are lots of limitations, we can improve malocclusion and achive proper facial profile with non-surgical treatment
Case Summary : We report the case of a 18-year-old woman who had a skeletal Class II malocclusion, mandibular retrognathism, large overjet(6.0mm), lip protrusion, and temporomandibular loint symptoms of clicking sound on both TMJ. Patient was diagnosed with degenerative joint disease(DJD) of TMJ through clinical and radiographic examination. Before orthodontic treatment, the stabilization splint was delivered. By using the splint, patient condyle stabilized, but anterior open bite was observed. To improve lip protusion, we extracted upper first premolars and lower second premolars. We totally intruded and distalized upper and lower arch with temporary anchorage divece in order to rotate the mandible in a counterclockwise direction. Also space closure was done with temporary anchorage device. After treatment we could establish proper occlusion and achieve proper facial profile.
Conclusion : Non-surgical treatment of skeletal class II adult with TMD was done with temporary anchorage and carefully selected force system. During orthodontic treatment, there were no symptoms and signs of TMD. After treatment, patient should have regular examination of temporomandibular joint.

P-050

Correction of gummy smile with maxillary vertical excess through orthognathic surgery

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Introduction : Esthetic smiles are one of the important objectives of the orthodontic treatment. The esthetics of smiling basically depends on the relations between three anatomic components: gingiva, teeth and lips. Among them, excessive exposure of gingiva is called ‘gummy smile’, which is the chief complaint of many patients. The etiology of gummy smile involves dento-periodontal, muscular and skeletal origin. Depending on the origin of the excessive gingival exposure, treatment may be performed surgically or non-surgically. This case deals with gummy smile with skeletal origin, which includes maxillary vertical excess, and considerations for the surgical approach will be discussed.
Case Summary : An 18-year-old female patient had chief complaint of facial asymmetry and excessive gingival exposure. Orthognathic surgery was planned to correct skeletal problems, including maxillary vertical excess and asymmetric mandible. After pre-surgical orthodontic treatment, 2-jaws surgery was performed with total impaction of maxilla and asymmetric setback of mandible. As a result, a patient showed a harmonious skeletal relationship and an esthetic smile with proper gingival exposure.
Conclusion : With the development of miniscrews, many cases of gummy smile can be improved in non-surgical approach through intrusion of the maxillary incisor without molar extrusion. In the case of skeletal origin, non-surgical methods, however, cannot improve maxillary vertical access itself, and therefore cannot improve non-harmonious ‘long face’. Barvant said that in the cases of gummy smile with skeletal origin and extending beyond premolars, isolated orthodontic treatment would not improve excessive gingival exposure. Therefore, surgical approach can bring more esthetic results than non-surgical methods in patients with maxillary vertical excess. Also, in patients who need surgery due to other skeletal problems, surgical approach is less burdensome for patients, and is also efficient in terms of reducing overall treatment period.

P-051

A case report of bilateral maxillary canine impaction in a pediatric patient

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Introduction : The maxillary permanent canine is the second most commonly occurring teeth impaction, with incidences of 1 to 2 percent and even higher in patients needing orthodontic treatment. However, maxillary canine impaction is complex in its etiology, localization, response to preventive treatments, and prediction. Determining whether impaction will occur and timing the treatment modalities that are affected by impacted canine(s) are paramount for a successful outcome. We would like to report a case of bilateral maxillary canine impaction in a child with Class III malocclusion.
Case Summary : We report the case of a 9-year male patient who had a skeletal Class III malocclusion, anterior edge to edge bite, bilateral peg lateralis (#12, 22), bilateral canine impaction (#13, 23). He had buccally horizontal impaction of #13, 23, as a result of CBCT evaluation. The window opening and bonding attachment were performed for impacted teeth; the buttons with metal chain on the palatal surface of the impacted #13, 23. We attracted these impacted teeth with superthread and nance holding arch with customized TMA spring and the maxillary teeth were bonded with fixed orthodontic appliance (MBBS) to regain the spaces for #13, 23. Gradually, the impacted teeth were well trained and arranged without the root dilacerations or root resorption, and did not accompany sequelae such as gingival recession. Face mask and RME were also used to improve skeletal Class III malocclusion. The total duration of treatment was 4 years and 6 months.
Conclusion : Early identification of impaction and accurate localization of the impacted tooth are the essential diagnostic process for successful treatment. The use of CBCT improved the diagnostic capabilities and improved the chances of success in the more difficult cases.

P-052

Maxillary protraction using Miniplates providing skeletal anchorage in older children with skeletal class III malocclusion

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Introduction : Maxillary protraction has been advocated for treatment of growing class III malocclusion with maxillary deficiency. Tooth-borne rapid palatal expansion (RPE) appliance as anchorage have experienced side effects such as loss of dental anchorage, proclination of the maxillary incisors. Additionally, tooth-borne rapid palatal expansion (RPE) has difficult to use in older children who need greater anchorage and long-term treatment. These problems can be solved by using miniplates in infrazygomatic crest as skeletal anchorage for maxillary protraction.
Case Summary : This case report presents the treatment of a 10.8-year-old boy with a Class III malocclusion and maxillary deficiency. The patient was an older child with mixed dentition, and it was thought that greater anchorage and long-term treatment would be required for successful maxillary protraction. Therefore, it was decided to use miniplates in the infrazygomatic crest as a skeletal anchorage. Under general anesthesia, two miniplates were installed bilaterally in the infrazygomatic crest of the maxilla between the permanent maxillary canines and first premolars. Maxillary protraction was applied with a force of 450-500g per side applied 12 to 14 hours per day. 9 months later, upper removable expansion appliance was delivered to expand maxillary arch and eliminate of anterior occlusal interference. After 17 months later, the maxilla was protracted successfully and positive overjet and overbite were achieved. Thereafter, maxillary protraction was limited to nighttime for 13 months for retention.
Conclusion : Maxillary protraction using miniplates providing skeletal anchorage is effective for older children with skeletal Class III malocclusion with maxillary deficiency being required greater anchorage or long-term treatment.

P-053

Orthodontic treatment with clear aligners using Artificial intelligence (AI) based optimal tooth alignment solution

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Introduction : Clear aligner treatment has gained a great popularity due to certain advantages over traditional fixed appliance such as improved aesthetics, comfort, oral hygiene, periodontal health, and lack of soft tissue irritation. Recently, the increasing use of three-dimensional (3D) intraoral scan and cone beam computed tomography (CBCT) data in orthodontics has boosted the development of 3D image-based AI systems for clear aligner treatment.
Case Summary : We reported clear aligner treatment in 3 patients with Class I malocclusion. They had mild to moderate anterior crowding, and non-extraction treatment was applied. The Artificial intelligence (AI) based optimal tooth alignment solution provided automated diagnosis, treatment planning, set-up and staging, and prediction of treatment outcome. AI solution also determined the site and amount of interproximal reduction (IPR) or arch expansion, and the design of bonded resin attachments. The treatment duration was 6 to 12 months and the number of clear aligners was ranged 18 to 21. The treatment results were superimposed with predicted treatment outcome, which showed great accuracy of AI based clear aligner treatment.
Conclusion : This case reports open up a new generation of clear aligners treatment, which is based on the AI generated treatment goal and staging combined with 3D digital technology. It would be expected that this system can provide good guidance for clear orthodontic treatment for less-experienced orthodontists as well as chance to minimize the possible human errors. Furthermore, the over-all treatment outcomes such as achievement and efficiency of the orthodontic treatment could be increased by the continuous researches and developments of AI technology in the near future.

P-054

Camouflage Orthodontic Treatment of Adult Hyperdivergent Skeletal Class II Malocclusion Using Total Intrusion Mechanics

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Introduction : With the development of skeletal anchorage, some of the skeletal improvements expected through growth control or orthognathic surgery have become possible. In the case of hyperdivergent skeletal class II malocclusion with vertical maxillary excess, it is possible to partially improve the skeletal discrepancies through treatment mechanics that promotes counterclockwise rotation of the mandible. For normal or deep overbite cases, it requires complex total intrusion mechanics including a large amount of anterior teeth intrusion.
Case Summary : Three cases of adult female patients who wanted improvement of mouth protrusion, retruded chin, and gummy smile are discussed. All of these patients were diagnosed with hyperdivergent skeletal class II malocclusion. Normal overbite and overjet with retroclined upper incisors and proclined lower incisors were observed due to dentoalveolar compensation. Some patients had temporomandibular joint disorder or root resorption with a history of previous orthodontic treatment.
Orthodontic treatment was planned and performed through upper and lower premolar extraction and total intrusion mechanics using orthodontic mini-implants. With successful total intrusion, significant skeletal improvement with functional occlusion was achieved by counterclockwise rotation of the mandible. Root resorption progressed in some patients.
Conclusion : Through total intrusion mechanics using orthodontic mini-implants, skeletal discrepancy and facial profile can be significantly improved in adult hyperdivergent skeletal class II malocclusion. It can achieve a true 'camouflage' effect that improves skeletal discrepancy without the need for orthodontic surgery, which may be closer to the goal of orthodontic treatment through functional occlusion and esthetic improvement. In terms of stability, it is not insufficient compared to growth control treatment, so the scope of orthodontic treatment can be further expanded.
However, there are disadvantages such as the need for complex treatment mechanics using multiple orthodontic mini-implants, a relatively long treatment period and increased possibility of root resorption, so careful case selection and application is required.

P-055

Deep Bite Treatments with a Short Face Patient Using Intrusion Arch and Anterior Bite Plate

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Introduction : In treating orthodontic patients, one of the most frequently encountered problems is a deep bite. There are basically two ways to treat a deep bite : 1) Intrusion of incisors, 2) Extrusion of molar. Among these methods, extrusion of molar is generally unfavorably treatment option in adult patients because of its unstable post-treatment retention. Therefore, we introduce a deep bite case in which an adult patient with a hypodivergent skeletal pattern strategically utilized the extrusion mechanism at the initial stage of treatment.
Case Summary : A 22-year-old man had chief complaints of deep bite, linguoversion of both anterior teeth. In lateral cephalometirc analysis, the patient showed skeletal Class II and hypodivergent skeletal pattern. Intra-orally, he had Angle's Class I, severe deep bite (10.0mm), crowding on both dentitions, deep curve of Spee, gummy smile. At the initial stage of treatment, we decided to use an anterior bite plate for extrusion of molars. Then, Burstone's intrusion arch was used to actively intrude anterior teeth. After 27 months of treatment, deep bite, curve of Spee, gummy smile were resolved with facial improvement.
Conclusion : In deep bite cases, vertical control is an essential process for successful orthodontic treatment. In the case of a hypodivergent skeletal pattern, considering improvement of lateral profile, it is effective ways to extrude the posterior. However, extrusion stability cannot be guaranteed in non-growing patients. Especially in adult hypodivergent patients like this case, it tends to relapse due to strong posterior occlusion or muscle elongation when the posterior occlusion exceeds the occlusal freeway. Therefore, in adult patients with a hypodivergent growth pattern, it is considered that the effectiveness of treatment can be increased through the use of a strategic extrusion mechanism at the initial stage of treatment.

P-056

Orthodontic treatment with traction of maxillary impacted canine

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Introduction : The prevalence of impaction of the canine is 1~2%. The causes of impaction thought to be due to displacement of the dental germ, lack of space, abnormal blockage. Impaction of canine can cause root resorption of lateral or central incisors, cyst formation, functional and aesthetic problems. Although impacted canines are often found incidentally in a panoramic radiograph, CBCT is recommended to evaluate the degree of root resorption of adjacent teeth and to identify the location or eruption path. Before diagnosis, the orthodontist must identify the location and inclination of the impacted canine, the available space, the type of malocclusion, the patient's age, and the factors that interfere with eruption. In this presentation, we introduce two cases with different impacted positions of canine were subjected to open surgery and orthodontic traction.
Case Summary : The first case was a 40-year-old male who visited the hospital for spacing. The maxillary left canine was impacted bucally, and the maxillary left primary canine remained. After surgical exposure, orthodontic traction was performed.

The second case is a 14-year-old male who visited the hospital for the canines did not erupt. The both maxillary canines were impacted palatally. After surgical exposure and buccal traction, and root movement was performed to restore crown inclination.
Conclusion : For orthodontic treatment in patients with impacted maxillary canines, there are various treatment methods that can be selected by judging the location and structures around the impacted tooth. In the case of an impacted canine has not been properly treated at an early stage, the possibility of ankylosis increases, and it is necessary to prepare in the treatment plan. Through an accurate diagnosis process, it is important to establish a treatment plan based on an appropriate treatment method, considering the location of the impacted canine and the age of the patient.

P-057

Palatal Expansion in Patients with a Narrow Maxillary Arch

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Introduction : A transverse maxillary deficiency is a challenging problem, especially when it is combined with a severe anteroposterior jaw discrepancy. Using a microimplant-assisted rapid palatal expansion(MARPE) appliance can eliminate the need for multiple surgeries in patients with complex craniofacial discrepancies and secure the safety and stability of the transverse correction.
On the other hand, patients with midpalatal osteotomy do not have an uncomfortable period that is formed by using MARPE and midpalatal osteotomy allows have advantages for patients who want to perform 1st surgery or want to perform surgery early. And patients who are scheduled to have 2 jaw surgery can get palatal expansion with a single operation.
This case report shows the selection of treatment and treatment effects in patients with maxillary constriction and mandibular prognathism.
Case Summary : We present 2 patients with maxillary constriction and mandibular prognathism.
One patient was treated with MARPE in presurgical orthodontic treatment, and after correcting the maxillary constriction, two jaw surgery was performed for correcting the patient's asymmetry and mandibular prognathism.
The other patient was treated with midpalatal osteotomy for correcting the maxillary constriction, and midpalatal osteotomy was performed together with two jaw surgery for correcting the patient's asymmetry and mandibular prognathism.
Conclusion : This case report demonstrated that MARPE and midpalatal osteotomy are both will be effective and able to provide a great satisfaction to the patients who need palatal expansion.
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Each treatment method also differs in terms of duration of treatment, cost of treatment, risk and burden of surgery.
Thus, considering a number of advantages and disadvantages, appropriate treatment options should be provided to patients, and patients' preferences for treatment direction should also be considered.

P-058

Tooth extraction in pre-surgical orthodontics for skeletal class II malocclusion with narrow velopharynx;a case repot

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Introduction : Pre-surgical orthodontics is planned based on the presumed displacement of jaw in orthognathic surgery. Especially in skeletal class II malocclusion with mandibular retrognathism, lower premolar extraction is usually considered for declining of lower incisor protrusion and increasing anterior overjet.; making a sufficient horizontal space for protruding of mandibular jaw in orthognathic surgery. To relieve maxillary protrusion, retrusive movement and clock-wise rotation of maxilla can be considered. But in skeletal class II malocclusion with narrow velopharynx patients, this retrusive and clock-wise displacement of maxilla is disinclined expecting unfavorable prognosis of airway problems. Therefore, in early diagnosis stage of skeletal class II malocclusion a evaluation of airway is essential to avoid postsurgical airway troubles. In narrow airway patients who anticipating orthognathic surgery upper premolar extraction should be considered to relieve alveolar protrusion in maxilla by pre-surgical orthodontics before surgery. So, in this report, we selected 1 case of skeletal class II malocclusion with narrow velopharynx patients planning orthognathic surgery. During pre-surgical orthodontics upper and lower tooth were extracted. After space closure of these extraction spaces, this patient got two-jaw surgery.
Case Summary : A 22-year-old woman with skeletal Class II malocclusion, 80.32° SNA angle, 71.99° SNB angle, 136.84° U1/FH angle, 12.08mm overjet, downward occlusal plane planned orthognathic surgery. The superior airway space is 2.44 MM. In pre-surgical orthodontics upper and lower 1st premolars extracted. This space closed before surgery.
Conclusion : Upper and lower tooth extraction in pre-surgical orthodontics should be considered to skeletal class II malocclusion patients with narrow velopharynx.

P-059

Distalization of upper dentition with maxillary second molar extraction

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Introduction : In adult, when treating Class II malocclusion with large overjet and deep bite, options of extraction and non-extraction with distalization can be considered for acquiring space. Distalization with maxillary second molar extraction increase not only in amount of distal movement of the first molar than non extraction cases but also in efficiency of treatment period compared to the extraction case of premolars.
Case Summary : A 14-year-old female patient had a chief complaint of her large overjet and spacing on lower anterior dentition. In lateral cephalometirc analysis, she showed skeletal Class II, convex profile. Intra-orally, she had Angle's Class II, large overjet (6.5mm), deep bite (5.0mm), crowding on upper dentition, spacing on lower dentition, deep curve of Spee. After treatment, anteroposteriorly, molar relation was corrected through distalization with maxillary second molar extraction instead of extraction of premolars. And, vertically, deep bite and deep curve of Spee were improved through anterior bite plate and a Burstone's intrusion arch. After 17 months of treatment, Angle's Class I relationship, harmonious overjet, overbite was achieved.
Conclusion : When treating Class II malocclusion with large overjet and deep bite, compared to non extraction case, distalization with maxillary second molar extraction has some advantages by accelerating distalization of maxillary dentition such as reliving posterior crowding, improving molar relationship and protruded lips. On the other hands, compared to the case of extraction of maxillary premolars, it has the advantages of reducing the treatment period and preventing excessive lingual inclination of maxillary incisors, so it causes preventing excessive retraction of the lips. Therefore based on careful case selection, distalization with maxillary second molar extraction can be a viable choice to promote proper facial appearance and to resolve Class II malocclusion with large overjet and deep bite.

P-060

Combination(SSRO+IVRO) Surgery-first Approach in Skeletal Class I Patient with Facial Asymmetry and Degenerative Joint Disease

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Introduction : Facial asymmetry is associated with various etiologic factors. Among these etiologic factors, temporomandibular disorders (TMDs) could significantly affect facial esthetics by morphological change of condyle. On the other hand, facial asymmetry has been considered contributors to disturbance in TMJ loading and worsen TMDs. In any case, it is important to improve both facial asymmetry and TMDs.
Clinicians must consider that surgical procedures could directly affect TMDs. Thus, for the treatment plan of surgical-orthodontic treatment, postoperative displacement of proximal and distal segment of mandible should be exactly predicted to prevent excessive loading on temporomandibular joint (TMJ) due to bony interference and undesirable fixation. In these days, surgical-orthodontic treatment with 3D virtual surgery has improved treatment result with more predictable and precise skeletal change after orthognathic surgery.
Case Summary : The patient was a 24-year-old man with a chief complaint of facial asymmetry. Before visit our clinic, he had been received TMDs treatment diagnosed with degenerative joint disorders on left TMJ. After the treatment, stable condition of left TMJ was confirmed. Skeletal Cl I with facial asymmetry and hypodivergent facial type was observed. Facial asymmetry pattern was canting-dominant type with right deviation of mandible. At the 3D virtual surgery, large displacement of proximal segment at non-deviated side was confirmed. Therefore, on the left side, intraoral vertical ramus osteotomy (IVRO) was performed instead of sagittal split ramus osteotomy (SSRO) to promote physiologic bony remodeling and avoid excessive loading on TMJ due to internal fixation. Post-surgical orthodontic treatment using digital set-up was progressed rapidly because of regional acceleratory phenomenon by surgery-first approach.
Conclusion : In this case, improved facial profile and post-treatment stability of TMJ were achieved by applying unilateral IVRO and SSRO surgery with 3D virtual surgery. It is recommended to be more careful to establish surgical-orthodontic treatment plan for the patient who had been diagnosed with TMDs.

P-061

Non-extraction Orthodontic Treatment of Etopic Canine Using Molar Distalization

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Introduction : With the recent development of orthodontic mini-screws, molar distalization has become easier and simpler than before. As patients want to preserve their teeth, there are increasing cases of non extraction treatment using distalization. When using a mini-screw for distalization, it is necessary to consider the appropriate location for mini-screw placement and the appliance depending on the type of tooth movement for each patient. In this case, the molar distalization was used to regain the eruption space of the maxillary canine and correct the Angle's molar relationship.
Case Summary : A 11-year-old male patient who had chief complaint of etopic canine of #13 with crowding on both dentition visited dental clinic. He also showed Angle's Class II molar relationship and skeletal Class II. We attemped to distalize maxillary molar with midplatal SAS and modified lingual arch for space regaining of #23 and correction of Angle's molar relationship. It was observed on superimposition that the molar distalized in the form of bodily movement using a palatal mini-screw and modified lingual arch. The maxillary molar were distalized 2.0mm and Angle's Class I molar relationship was obtained.
Conclusion : The amount of molar distalization with palatal mini-screw is relatively higher than in the case of using the buccal mini-screw because it is not affected by narrow interradicular space. The failure rate of mini-screws on the palatal side is 2.1%, which is lower than the buccal mini-screw. In addition, iatrogenic damage such as root perforation does not occur. When palatal mini-screw is used as an anchorage for molar distalization with modified lingual arch, line of action of force can be applied close to the center of resistance. Therefore distal-tipping and extrusion of molars are less, which is advantageous for bodily movement.

P-062

Pre-surgical Decompensation of Lower Incisors relative to Chin(menton) in Patients with Facial Asymmetry using CBCT

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Introduction : Orthodontic decompensation of lower incisors is important especially in surgery for facial asymmetry. If orthodontists, in consultation with the surgeon prior to surgery, can assess the amount of decompensation and arrange the lower incisor relative to chin(menton), chin deviation can be corrected sufficiently, and accordingly, excessive contouring operation and efforts to match the dental midline after surgery can be reduced. The purpose of this study is to suggest a criteria for transversally decompensating the midline and the level of lower incisors relative to the chin deviation and contour in orthognathic surgery of asymmetric patients, and to show a case using this.
Case Summary : We report a case of 25-year-old female patient with skeletal Class I malocclusion, facial asymmetry to left, bialveolar protrusion, and hyperdivergent profile. 2 jaw surgery was planned for improvement of skeletal discrepancy. After initial leveling, CBCT was taken and 3D volume rendering was completed using InVivo5 software. After positioning the mandible considering the menton and gonion, two discrepancies were evaluated : distance between the lower midline and vertical line of the most inferior tangent of chin, and the level between the lower incisor edge and the most inferior tangent of chin(menton). For the former discrepancy, an open coil spring was used to decompensate the lower midline. And the discrepancy of level was controlled by stepped wires. Another CBCT was taken just before surgery to check the decompensation. After surgery, asymmetry of the mandible is improved and the dental midlines are coincided in post-surgery CBCT.
Conclusion : Prior to orthognathic surgery in patients with facial asymmetry, evaluating necessary decompensation of lower incisors using CBCT can be done through close collaboration with surgeons to find a best compromise, which can reduce the amount of excessive chin contouring and the post-o ○ perative efforts to coincide dental midlines.

P-063

Improvement of the Smile Esthetics in a Middle-aged Patient with a Missing Lower Second Molar

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Introduction : There are several treatment options for the management of patients with a missing mandibular second molar such as single-tooth implant or protraction of a posterior third molar. Size, shape, periodontal tissue and root length of the third molar should be taken into consideration to select the appropriate treatment plan. This case report illustrates a successful orthodontic outcome of a middle-aged skeletal Class II malocclusion with un-esthetic smile and a hopeless lower second molar.
Case Summary : A 40-year old female indicated skeletal Class II with protrusion with hopeless lower right second molar (#47). She also presented a gummy smile along with upper anterior crowding with size and shape differences between the central incisors and midline deviation. The overall Class II malocclusion and protrusion were corrected with total arch distalization and full arch impaction in the maxillary arch and total arch distalization in the mandible along with protraction of the right third molar (#48) to substitute for the missing second molar. Additional adjustment to level the gingival margin and reshaping of the left central incisor to correct the size and shape discrepancies between the maxillary central incisors provided favorable improvement of the smile esthetics as well.
Conclusion : Improvement the overall macro-esthetics as well as micro-esthetics and conservative treatment to substitute the third molar as a missing second molar provided satisfactory orthodontic treatment outcome in a middle-aged patient.

P-064

Orthognathic surgery and orthodontic treatment for cleft lip and plate with transverse and antero-posterior discrepancy

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Introduction : Patients with cleft lip and palate tend to show skeletal Class III malocclusion after puberty due to a decrease in growth of the maxilla with scar tissue and severe transverse and anteroposterior discrepancy of the maxilla. Most of these patients require orthognathic surgery accompanied by orthodontic treatment after growth is complete. It is necessary to consider the maintenance of stability after the completion of treatment.
Case Summary : An 18-year-old male patient with cleft palate visited our hospital with a mandibular protrusion. He underwent primary surgery and alveolar bone grafting for the bilateral cleft lip and palate. but a quad helix and a fan type expander were used to recover the severe transverse discrepancy that occurred during the growth period. Orthognathic surgery was performed to resolve mandibular protrusion. The treatment was completed in Angle's Class II molar relationship. For the stable maintenance of the arch shape, the missing teeth of the maxilla were restored with 3-unit bridge.
Conclusion : In cleft patients with maxillary undergrowth, the relapse rate after orthodontic treatment with orthognathic surgery is approximately 24-26%. So there is a discussion about over-correction for stability in patients with cleft lip and palate, but consideration of other anatomical structures such as VPI(velopharyngeal insufficiency) is necessary before surgery. And it is also important to maintain transverse stability after treatment. Prosthetic treatment of missing teeth to maintain the transverse width of maxillary arch after resolving constricted arch is effective for the stability of the arch.

P-065

Orthodontic Treatment of Patient with Sturge-Weber Syndrome

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Introduction : Nevus flammeus is characterized by abnormally enlarged capillaries and red spots. It appears in two forms of bilateral and unilateral type. Sturge-Weber syndrome is one of the syndromes that appear unilaterally with nevus flammeus, and malformations of capillaries in the skin as well as facial bones, soft tissues, eyes, and intracranial capillaries are observed. In particular, vascular malformations may be accompanied by blood vessels in hard tissue, so caution is required in orthodontic treatment.
Case Summary : A 15-year-old female patient who had Sturge-Weber syndrome with facial asymmetry came to the hospital. She had mild crowding, but there was severe occlusal canting (left down) on the side affected by nevus flame. This syndrome can be accompanied by malformations not only in the soft tissues but also in the blood vessels of hard tissues, and it is difficult to perform an invasive treatment on the affected side because it is vulnerable to bleeding. In order to solve the asymmetric canting of the face, miniscrews were placed in the palatal part of the non-affected side, and treatment results were obtained by improving canting.
Conclusion : The possibility of invasive treatment is determined according to the degree of disease in patients with nevus flammeus. Patients with Sturge-Weber syndrome have a similar appearance to patients who had general nevus flammeus, an appropriate treatment plan is required through differential diagnosis. The orthodontist must know accurately the characteristics of these skin vascular diseases, and orthodontic treatment should be properly implemented.

P-066

Early Treatment by Function Regulator II (FR II) in Growing Children With Mandibular Retrusion

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Introduction : Treatment of mandibular retrusion in growing children is generally started just before the peak growth period, but if the growth of the mandible is being inhibited due to excessive tension of mandibular muscles, treatment can be started earlier to improve the muscular environment. FR II is a useful appliance for early intervention in patients with mandibular retrusion with a vertical growth pattern accompanied by muscle functional problems.
Case Summary : This case report is about an 8.6-year-old girl with Class II malocclusion, showing lip cushioning, hyperdivergent skeletal pattern and mandibular retrusion. Although it is an early age to start treatment of Class II malocclusion, early treatment with FR II was decided to prevent deterioration of Class II skeletal relationship due to excessive tension of mandibular muscles and to improve the facial profile by counterclockwise rotation of the mandible. FR II is a functional appliance that induces the natural forward movement of the mandible to the space created by blocking the force of the surrounding muscles with a lip pad and buccal shield. In order to maximize the therapeutic effect, myofunctional training must be accompanied during the daytime. Using a fixed orthodontic appliance, the maxillary 4 incisors alignment was preceded, FR II was started, and at the same time, lip sealing training using a tongue depressor was instructed. After 1 year and 4 months of using FR II, the overjet was reduced and Class II molar relationships were improved. In the lateral cephalometric analysis, the ANB was decreased, and mandibular plane angle and gonial angle, which means vertical control of mandibular growth, were also reduced.
Conclusion : FR II is an effective functional appliance for early intervention in patients with mandibular retrusion who show muscle problems and has the advantage of vertical control of the mandibular growth when accompanied by myofunctional theraphy.

P-067

Non-extraction Treatment in Skeletal Class I Adults with Severe Deep Bite Using Corticotomy and Bone-Graft

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Introduction : Treatment of patients with severe anterior deep bite and excessive overjet needs sufficient tooth movement to achieve proper occlusion. However, this orthodontic movement might cause periodontal complications, including gingival recession, bony dehiscences, fenestrations due to the anatomical limits. Especially when patients have thin symphysis or labial bone, excessive tooth movement might lead to periodontal complication. When orthodontic treatment is combined with bone graft and corticotomy, accelerated tooth movement can be achieved by regional acceleratory phenomenon. By using this procedure clinician can prevent periodontal complications and achieve proper occlusion.
Case Summary : The patient who was 22 year of age came to the office with chief complaint of severe anterior deep bite. This patient was diagnosed with Skeletal Class I with hypodivergent growth pattern. Upper and lower incisors had severe lingual inclination and needed decompensation. Due to thin alveolus, corticotomy combined with bone graft was performed. Rapid tooth movement was achieved without any periodontal complication. After leveling and alignment, temporary anchorage device (TAD) was used to correct Dental Class II relation by distalization of upper arch. Total treatment period took 27 months and proper occlusion and facial profile was achieved without tooth extraction.
Conclusion : With the association of corticotomy and bone graft it is possible to overcome anatomical limits and avoid periodontal complication in orthodontic tooth movement. By this procedure patients tooth movement can be accelerated by regional accelerated phenomenon and total treatment period can be reduced.

P-068

Non-surgical Treatment Case of ClassⅢ Malocclusion with Asymmetry

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Introduction : Skeletal class 3 malocclusion is a condition in which the mandible is positioned anteriorly compared to the maxilla. However, skeletal Class III malocclusion frequently involves various problems related to mandibular overgrowth. Horizontal disharmony due to size or position disharmony, jaw asymmetry, etc. As first method, surgical treatment is considered. But if it is not accepted, non-surgical methods are used.
The following is a case of non-surgical treatment for a patient with skeletal class 3 malocclusion, horizontal discrepancy, and asymmetry.
Case Summary : *Chief complaint
“I can’t eat well”.

*Diagnosis

horizontal disharmony both sides of the molars
compensatory torque is generated in the molars.
anterior crossbite
horizontal asymmetry of the jaw
3 incisor of mandibular anterior teeth
crowding

1. maxillary expanding
2. #44 extraction & mandibular retraction

improvement of buccal crossbite
improvement of anterior crossbite
stable occlusion settling

remain #38,48 prevent for #17,27 extrusion
Conclusion : After about 2 years of treatment, the patient's horizontal and anteroposterior crossbites were improved.

Horizontal malocclusion of the posterior teeth due to asymmetry or size mismatch of the upper and lower jaws should be improved from the beginning of treatment.

1. It makes subsequent treatment easier.
2. It makes the anterior overbite properly.
3. Facilitates the planning and progress of surgical correction.

P-069

Open Bite Treatment in Temporomandibular Disorder Patient with Mini-Plate and Multiloop Edgewise Arch Wire Technique

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Introduction : Patients with temporomandibular disorder often show anterior open bite tendency. In open bite treatment, before invention of the orthodontic mini-implant, the Multiloop Edgewise Archwire (MEAW) was usually used. The main principles of MEAW are intrusion and distal tipping of molars and bicuspids, and extrusion of incisors. Recently after invention of the mini-implant, the first treatment option for open bite correction, is intrusion of upper posterior segments, which induces clockwise rotation of the mandible. However, if insertion of the mini-implant is difficult because of anatomical limitation, a mini-plate can be an efficient method. When the mini-implant or mini-plate is combined with MEAW, it can be an efficient way to correct open bite.
Case Summary : We report the case of a 25-year-old woman who had a temporomandibular disorder, skeletal class II malocclusion, anterior open bite, and crowding. Maxillary and mandibular fixed orthodontic appliances were used for leveling and alignment of teeth, and mini-plates were used for intrusion of upper molars. After leveling, alignment, and intrusion, upper MEAW and elastics were utilized for further open bite correction. As we can see in the pre-treatment, post-treatment and retention photographs and radiographs of this patient, the treatment results were effective and stable.
Conclusion : Fixed orthodontic treatment with maxillary mini-plates and Multiloop Edgewise Archwire (MEAW) was performed to correct patient's malocclusion, especially anterior open bite

P-070

ORTHODONTIC TREATMENT OF CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD)

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Introduction : Attention deficit hyperactivity disorder(ADHD) is a common neurodevelopmental disorder with onset of symptoms typically in early childhood. First signs of the disorder, including language delay, motor delay and temperament characteristics, may be evident as early as infancy. Children with attention deficit hyperactivity disorder (ADHD) have more sleep breathing problems, dental malocclusion and parafunctional oral habits than individuals without ADHD.In this case report, we present the case of functional appliance treatment for children with Class II malocclusion and ADHD.
Case Summary : This case is a 10-year-old boy with attention deficit hyperactivity disorder (ADHD). He has skeletal CII malocclusion and hyperdivergent facial type. There is excessive overbite and overjet, Lower lip cushion effect and lip incompetency. We used Class II activator for mandibular advancement. After 2 months, High pull headgear was applied after monitoring of patient's cooperation. There was often appliance's breakdown but treatment was continued slowly. After 1 year the profile was improved and overjet was decreased. Lip incompetency was disappeared, tongue thrusting habit was stopped. Continuing listening to patient's psychological condition was required. The first stage of orthodontic treatment was carried out for 2 years 6 months. The second stage of orthodontic treatment with fixed appliance was delayed since we were not convinced about patient's cooperation.
Conclusion : In children with attention deficit hyperactivity disorder (ADHD), it is possible to stop the parafunctional oral habit and obtain stable occlusion if we induce patient's orthodontic treatment cooperation. Orthodontic treatment of children with ADHD is limited but we can improve facial profile and correct skeletal discrepancy by using the functional appliance combining therapy with ADHD medications. Further studies are needed to help orthodontic treatment in children with ADHD.

P-071

Gingival Recession on Mandibular Incisors in Skeletal Class III Malocclusion Patients with Orthognathic Surgery

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Introduction : Many individuals experience some pathology of the gingiva or periodontium as they are getting older, and so further recession of the gingiva is common. Bacterial plaque is the main etiologic factor in periodontal breakdown. Labial movement of incisors in some patients can be followed by gingival recession and loss of attachment. In surgical-orthodontic patients, suture lines contract somewhat as they heal, and when sutures are placed in the vestibule, this can lead to recession of the gingiva.
Case Summary : We report 35-year-old male patient who had no evidence of gingival recession during pre-surgical orthodontics, and 5 weeks after orthognathic surgery. But after 5 months, there is a sign for gingival recession on #41. We're following him up now on. We report another case of 24-year-old-female patient who got subepithelial connective tissue graft on #31, 41 before surgical-orthodontic treatment. There was no significant gingival recession during surgical-orthodontic treatment. We followed her up for almost 5 years, and she got good retention.
Conclusion : When treating patients with class III malocclusion, it is very important to consider gingival recession in the mandibular anterior region. Orthodontically, IMPA and basal bone morphology are important factors for gingival recession, and surgically, contraction of the suture line is also an important factor. Therefore, before orthodontic treatment, it is necessary to think about performing free gingival graft to prevent gingival recession. If tooth movement is done carefully, the chance of recurrence will be very low.

P-072

Airway Dimension Change After Molar Intrusion in Anterior Openbite Patients : Case Report

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Introduction : Anterior Openbite patients often show retrognathic mandible and hyperdivergent pattern with smaller airway. Molar intrusion with skeletal anchorage treatment leads anterior openbite closure and mandibular counterclockwise rotation. The mandible is connected to the hyoid bone and tongue through muscles so its location can affect the size of the pharyngeal airway space. The objective of this report is to present and discuss pharyngeal airway dimension change after molar intrusion in openbite cases.
Case Summary : A-25-year-old woman was referred for orthodontic consultation. Her chief complaint was discomfort in temporomandibular joint. The cephalometric and clinical analysis showed a skeletal Class I, dental Class II relation with anterior openbite. After splint therapy, molar intrusion with skeletal anchorage was performed. A-14-year-old girl presented with temporomandibular joint soreness and anterior openbite. Clinical and radiographic examinations revealed skeletal Class II with retrognathic mandible and anterior openbite. After 1 year of splint therapy, treatment of molar intrusion using skeletal anchorage was performed. A-17-year-old boy with a skeletal Class II with mandibular retrusion and steep mandibular plane with anterior openbite reported with chief complaints of anterior openbite. The patient was treated on non-extraction basis and molar intrusion using skeletal anchorage was performed. After orthodontic treatment, molar class I relation, anterior normal overjet and overbite was achieved in all three cases. The posttreatment cephalometric radiograph and superimposition tracings of three patients showed counterclockwise rotation of the mandible. Increase in pharyngeal airway space was observed due to mandibular counterclockwise rotation.
Conclusion : The result of these three cases shows that counterclockwise rotation of the mandible through molar intrusion can increase pharyngeal airway dimension.

P-073

Asymmetric Extractions in Orthodontic Treatment: Case Report

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Introduction : The objective of orthodontic treatment is to form a normal teeth relation. In the past, preserving all teeth was the basic principle, but in many cases, extractions are unavoidable to prevent recurrence and enhance stability after treatment. Especially, asymmetric extractions can make treatment mechanics easy and improve a treatment result when extractions are required due to the incorrect central line and the poor unilateral molar relation. We introduce three cases that had incorrect central lines due to unilateral high canine, mandibular 3 incisors, mandibular asymmetry and mild skeletal class III relation, but improved central lines through asymmetric extractions.
Case Summary : Case I : Extractions of #14 and 44 was applied to improve skeletal class II relation, left class II molar relation, upper right high canine, central line difference caused by lower left displacement, missing upper left 2nd premolar.
Case II : Extractions of #14, 24 and 44 was applied to improve mandibular 3 incisor and central line difference caused by lower right deviation.
Case III : Camouflage treatment with an extraction of #44 was applied to improve skeletal class III relation, class III molar relation, central line difference caused by chin deviation.
Conclusion : Extraction has become indispensable to resolve crowding caused by teeth-dental arch discrepancy, or discrepancy of dental arch position. When there is a central line difference due to asymmetric molar relation, mandibular 3 incisors and skeletal problems, an asymmetric extraction is one of good treatment options.
Asymmetric extractions were conducted for three cases with different problems.
As a result, the period of treatment shrank because orthodontic mechanic became easy and tooth movement decreased. Although there was a difference between right and left molar relations, the central lines improved with no functional and aesthetic problems. Even when there was a mild horizontal skeletal problem, stable camouflage treatment was possible with asymmetric extractions.

P-074

Orthodontic Traction Of Vertically Impacted Mandibular Canine Using Mini-implant For Temporary Skeletal Anchorage Devices

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Introduction : Orthodontic treatment of impacted teeth can be a clinical challenge because of anchorage control and limited access. For successful treatment on the impacted tooth, clinicians should figure out 3-dimensional location of the impacted tooth. Application of an appropriate force system using temporary anchorage devices (TADS) and levers is a simple and effective way to erupt the impacted tooth. We present one case with impacted mandibular right canine using mini-implant for temporary skeletal anchorage devices.
Case Summary : We report the case of a 47-year female patient with the chief complaint of impacted mandibular right canine. Vertically impacted mandibular right canine was uprighted with mini-implant inserted in the buccal side of mandibular right posterior teeth and a buccal lever for orthodontic traction. After confirming the positional change of the impacted teeth, we started to regain the spaces with fixed orthodontic appliance in the mandibular arch using interproximal reduction on mandibular anterior teeth for alignment of the canine. The total treatment period was 11 months. The impacted teeth was well arranged without root resorption of adjacent teeth, gingival recession and finally stable occlusion was regained.
Conclusion : Clinicians should consider 3-dimensional location and desired movement of the impacted canine for eruption. Also, available space should be analyzed for alignment of the impacted tooth to prevent periodontal problems after treatment. An orthodontic mini-implant in posterior teeth and buccal lever were performed for efficient orthodontic traction of the impacted tooth.

P-075

Restoration of Vertical Bone Defect via Major Root Movement

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Introduction : Ankylosis of a molar during active growth leads to a significant vertical bone defect, extrusion of the opposing molar, and inclination of adjacent teeth. Treatment timing is an essential factor for the patient's quality of life. Early Extraction of the ankylosed molar and protraction of the second molar is challenging because of the difficulty of tooth movement and the uncertainty of the normal eruption of the third molar. In view of the uncertainty of eruption of the mandibular third molar, it is essential to assess the potential for eruption according to the developmental stage of the third molar and to secure sufficient space for eruption.
Case Summary : This is a case report of an early pubertal patient with an ankylosed mandibular first molar on the right side. In this case, a girl with an ankylosed right mandibular first molar and an advanced vertical bone defect was treated via early extraction of the ankylosed molar along with the intrusion of the maxillary first molar and mesial root movement of the mandibular second molar before the initiation of mandibular third molar root formation.
Conclusion : By early replacement with mesial root movement of the mandibular second molar, restoration of the vertical bone defect was noted at the end of treatment. In addition, spontaneous eruption of the mandibular third molar was observed, which was in contrast to the mesioangular impaction of the contralateral third molar. A favorable intraosseous movement of the tooth germ occurred when the development was in its early stage. This case emphasizes the importance for treatment timing to increase the chance of utilization of the third molar.

P-076

Orthodontic Treatment of a Patient with Multiple Congenital Missing Teeth and Odontogenic Sinusitis

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Introduction : Pneumatization of maxillary sinus or sinusitis is one of the anatomic limitations of orthodontic treatment. Tooth movement through sinus is a challenging task due to high risk of complications such as root resorption, loss of pulp vitality, alveolar bone loss. This case describes orthodontic treatment in a patient with multiple teeth missing accompanying odontogenic sinusitis and pneumatized maxillary sinus.
Case Summary : A 22-year-old female visited our clinic with the chief complaints of multiple congenital missing, lower spacing and lip protrusion. She was diagnosed as skeletal and dental class I with upper dental midline deviation 3mm to the left, multiple congenital missing of all four second premolars, and prolonged retention of the right deciduous maxillary first molar. In addition, severe right maxillary sinusitis and broad pneumatization were observed around the remaining deciduous tooth. The patient was referred to otorhinolaryngology(ENT) for evaluation of sinusitis and went endoscopic sinus surgery(ESS). According to prognosis of maxillary sinus after ESS, possible dental treatment options were (1) implant with bone graft (2) 3-unit bridge (3) full arch orthodontic treatment. The prosthetic approaches had advantages of being relatively quick and easy, but could not resolve midline discrepancy and lip protrusion. The orthodontic treatment can solve these problems, but anatomic limitation remains due to sinusitis/pneumatization. Considering patient's chief complaints and age, comprehensive orthodontic treatment would be a reasonable option if tooth movement through pneumatized sinus is possible. Midline correction, lip retraction were achieved by the maxillary arch rotation and space closure of the missing premolars. After orthodontic treatment, the right maxillary sinusitis was healed and new alveolar bone formation around the pneumatized sinus was observed.
Conclusion : In a patient with multiple missing teeth and odontogenic sinusitis, an orthodontic treatment could be carefully carried out to establish facial esthetic and occlusion function.

P-077

A 7-year Orthodontic Management of a Patient with Idiopathic Multiple Teeth Eruption Disturbance

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Introduction : Multiple teeth impaction is often associated with abnormal intra-alveolar environment such as cyst, odontoma, and supernumerary tooth or with metabolic, hormonal disorders and syndromic diseases, for instance, cleidocranial dysplasia, Gardner's syndrome, and Down syndrome. This case report illustrates a successful treatment outcome of a rare patient with idiopathic eruption disturbance of multiple teeth without any syndrome or systemic disorder.
Case Summary : An 11-year-old male patient visited the orthodontic department of Seoul National University Bundang Hospital with a chief complaint of unerupted upper anterior teeth. The patient was initially diagnosed with delayed eruption of maxillary incisors (#11, 12, 21, 22). He had no systemic condition or familial history which may cause such disturbance of normal teeth eruption. Firstly, the surgical window opening of maxillary central incisors (#11, 21) and their orthodontic traction was done using modified Nance-holding arch. Maxillary lateral incisors showed normal eruption, but multiple other permanent teeth showed no physiologic progress of eruption. Therefore, sequential orthodontic traction of maxillary premolars (#14, 24), mandibular left canine and premolars (#33, 34, 35, 44, 45), and maxillary canines (#13, 23) was proceeded with surgically closed eruption technique using modified trans-palatal arch, modified lingual arch and orthodontic miniscrews, respectively. Considering patient's age, he was placed under observation for the eruption of the second molars (#17,27,37,47). Despite more than 1 year of follow-up, all four second molars showed no eruptional change and were diagnosed with impaction, therefore underwent surgical window opening and orthodontic guided eruption by modified trans-palatal arch and modified Halterman appliance. After successful traction of all impacted teeth, the appropriate occlusion of full permanent dentition was accomplished by fixed orthodontic appliance.
Conclusion : Precise diagnosis, timely intervention and careful surgical-orthodontic management in an adolescent patient with idiopathic multiple teeth eruption disturbance resulted in successful rehabilitation of oral function and esthetics with full permanent dentition.

P-078

Nonsurgical Treatment of Anterior Open Bite Patient : Considering Facial Esthetics

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Introduction : Anterior open bite occurs by complex reasons including skeletal, dentoalveolar, functional and habitual factors. 2 treatment plans can be considered; orthognathic surgery and non-surgical treatment by using anterior tooth extrusion and molar intrusion. Anterior open bite treatment options should be influenced by facial esthetics and the amount of incisor display at rest and during smile. This report introduces a case of forming normal overjet and overbite while achieving aesthetic improvements through non-surgical treatment of an open bite patient.
Case Summary : Following patient had class III skeletal malocclusion with anterior open bite, arch width discrepancy and lacking incisor display. Orthognathic surgery and non-surgical orthodontic treatment were both planned but patient refused to take surgery. Thus open bite was corrected by palatal expansion and anterior teeth extrusion using inter-arch elastics which eventually lead to normal overbite, overjet and anterior teeth inclination. Adequate smile line was also gained by extrusion of maxillary anterior teeth.
Conclusion : Non surgical orthodontic treatment of open bite can be chosen strategically between anterior teeth extrusion and posterior teeth intrusion by considering vertical jaw-relation, anterior-posterior relation and incisor display. Introduction of skeletal anchorage system made it possible to efficiently solve open bite problems by molar intrusion. During diagnosis, synthetic assessment including skeletal factors and soft tissue factors such as incisor display, chin projections should be done for vertical adjustment. Myofunctional therapy is also required for post-treament rentention.

P-079

Non-surgical Orthodontic Treatment of Adult with Idiopathic Condyle Resorption Induced Openbite Relapse after Extraction Treatment

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Introduction : Idiopathic condyle resorption (ICR) of temporomandibular joint (TMJ) often occur before, during orthodontic treatment, or retention, and can cause anterior openbite and malocclusion. The treatment of adult patients with severe anterior openbite is challenging and orthognathic surgery can be considered based on the severity of skeletal discrepancy. This case report describes non-surgical orthodontic treatment of an adult patient with severe openbite relapse due to ICR, occurred during retention after extraction orthodontic treatment in adolescence.
Case Summary : A 19-year-old female, who had skeletal and dental class II malocclusion, severe anterior openbite of 4mm and overjet of 4mm combined with ICR, visited department of orthodontics at SNUBH. The patient had previous orthodontic treatment history with extraction of four first premolars 8 years ago. Before orthodontic re-treatment, the ICR of TMJ was evaluated at oral and maxillofacial surgery. Conservative treatment including stabilization splint, laser therapy, and medication was performed for 1 year. As the first treatment option, orthognathic surgery was considered to improve the jaw relationship and openbite. However, the patient was reluctant to surgery. As its alternative, camouflage orthodontic treatment was planned to induce mandibular counter-clockwise rotation through intrusion of maxillary molars and total mandibular arch distalization. Maxillary total arch distalization and molar intrusion were carried out using modified C-palatal plate (MCPP) with palatal retraction arch (PRA) bonded on the first maxillary molars. After the maxillary arch distalization with intrusion and mandible autorotation, mandibular total arch distalization was achieved using miniscrews to increase overjet and overbite. At debonding, the improvement of facial profile and functional occlusion with proper overjet and overbite was established.
Conclusion : In a patient with severe mandibular retrusion and openbite due to ICR, orthodontic camouflage treatment using MCPP and miniscrews accompanied with conservative TMD treatment could improve facial esthetics and occlusion.

P-080

Facial Profile Changes Through Maxillary Dentition Anteroinferior Displacement And Mandibular Rotation In Class III Malocclusion

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Introduction : The class III treatment is always challenge. A main issue of Cl III treatment is the chin protrusion and crossbite. and in severe skeletal Cl III patients, we are considering that whether or not surgery should be performed. A Class III malocclusion treatment with skeletal anchorage facemask in last adolescent growth stage is a better choice.
Case Summary : The patient was 11years 10month female patient with the chief complaint of Chin protrusion and spacing. The clinical examination showed spacing of Mx.&Mn. dentition, crossbite in anterior and posterior dentition, chin protrusion and lower lip protrusion. and in radiographic examinations, she has a skeletal class III malocclusion with mandibular prognathism, hyperdivergent pattern and mandibular incisor uprighting, and growth stage is DP3u and CVM 4, that is in last adolescent growth stage. First, for correction posterior crossbite, we performed maxillary expansion with MSE. after that Using facemask with MSE. Facemask treatment was performed for about 1 years. Treatment results of successful anterior-inferior movement of maxillary dentition and clockwise rotation of mandible appeared. Upper lip was protruded but dramatically reduced chin protrusion through clockwise rotation of mandible. Finally, to close space of dentition, bracketing was progressed and total retraction with MIA was performed in maxillary and mandibular dentition. after 3year 6months, her profile has improved. she had the esthetic profile with lip&chin retrusion.

Conclusion : A very severe class III malocclusion patient was treated with non-surgical treatment, and overall the desired results were obtained. Surgery can reduce the absolute bone length, but non-surgical treatment cannot.
Therefore, it is essential that proper rotation of the mandible is used in the treatment process. In the treatment of class II malocclusion, intrusion is used, whereas in class III, clockwise rotation of the mandible can be appeared using extrusion, and the esthetics of the facial profile can be increased by chin retrusion.

P-082

Asymmetry Treatment in Growing Children Using Functional Appliances

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Introduction : In children with mixed dentition, asymmetry may be induced by tooth interference or inappropriate habits, and early approach may be required to prevent from causing skeletal asymmetry during growth or creating bad habits such as unilateral chewing. In this case report, we present two cases of functional appliance treatment for growing children who complained of asymmetry.
Case Summary : The first case is a 7-year-old girl who has anterior crossbite and asymmetry. About 4mm of mandibular deviation to the right side was observed. CIII activator was fabricated by obtaining a construction bite with midline corrected, and tooth interference was removed. After 3 months, crossbite was corrected, and the asymmetry was within 1mm. In order to expand insufficient space for eruption of permanent teeth, schwarz appliance was used for 6 months and then 2x4 appliance was bonded.
The second case is an 8-year-old boy who has asymmetry and difficulty in chewing. Total scissorbite on the left side with severe lingual inclination of #36, mandibular deviation to the right side about 3mm and constricted mandibular arch were observed. First, schwarz appliance with bite plate was used to expand the constricted mandible, then only the plate of #36 was removed, and a cross elastic was used from the #26 buccal side to the #36 lingual side. After 1 year of treatment, #36 was uprighted and scissorbite was corrected. And mandibular deviation and facial profile were also observed to improve naturally.
Conclusion : In children with mixed dentition, it is possible to obtain stable occlusion and improve facial profile by correcting dentitional asymmetry and interarch discrepancy using the functional appliance. If asymmetry is observed before the completion of permanent dentition, early intervention may be required at an appropriate time, which can achieve very effective results in a short period of time in growing children.

P-083

Vertical Control and Facial Improvement of Skeletal Class II Malocclusion Using Micro-Implant

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Introduction : Total arch intrusion and distalization using a micro-implant has been reported as effective treatment method and can be applied to vertical control of the dentition. This case report shows the patient of hyperdivergent skeletal Class II malocclusion with lip protrusion treated by total arch intrusion and distalization using a micro-implant.
Case Summary : 20Y11M / Female
Chief complaint: Lip protrusion
A 20-year-old female had a chief complaint of lip protrusion. She had skeletal Class II malocclusion and hyperdivergent skeletal pattern. She had a convex profile with a retrognathic mandible and marked lip protrusion and incompetency. To correct lip protrusion, she was treated with total arch intrusion and distalization using a micro-implant. After treatment, lip protrusion and incompetency was relieved. Protruded lips and convex profile were improved by total arch intrusion and distalization and counter-clockwise rotation of mandible.
Conclusion : Micro-implant is now commonly used for many types of malocclusion. Micro-implant is able to provide stable anchorage for tooth movements such as intrusion, protraction, and distalization. In this case, total arch intrusion and distalization using multiple micro-implant is viable option for the treatment of skeletal Class II malocclusion. Using stable and predictable micro-implant with acceptable treatment options and appropriate biomechanics will provide patients with esthetic and functional results and satisfaction.

P-084

Molar root uprighting with light wire

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Introduction : Impacted or mesially tipped molars are frequently encountered in daily orthodontic practice. It can occur due to various reasons including ankylosis of adjacent tooth or lack of space for eruption. If it is left untreated, more serious problems can be induced. Consequently, early detection and intervention is essential for the management of impacted or tipped molars.
Simple uprighting of the molar usually moves the crown distally while root position is maintained and space is opened. If impacted molar needs to be uprighted without creating space, considerable root movement is required.
This presentation described simple molar root uprighting technique by mesial root movement. Mini-tube appliance and 012 NiTi wire was used. Miniscrew was placed for indirect anchorage.
Discussion : In this case, conventional bracket could not be used because of limited surface area to bond bracket on the horizontally impacted lower third molar. Surprisingly, mini-tube appliance and light wire exerted sufficient moment to upright horizontally impacted third molar. With simple biomechanics, majority of root uprighting was conducted by mesial root movement.
Conclusion : Mini-tube appliance with light NiTi wire is effective in uprighting and mesially moving the root of impacted molar. Considerable root movement was observed and no space was found between uprighted molar and adjacent tooth.

P-085

Protrusion treatment case with extracting an upper central incisor and 3 premolars.

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Introduction : Patients with bialveolar protrusion are commonly treated with four premolar extraction. However, if there is a severe root resorption on a certain tooth, the tooth with severe root resorption should be extracted. This case report illustrated the successful protrusion treatment with extracting of 3 premolars and the upper left central incisor which had severe root resorption.
Discussion : 29 years old female patient visited with a chief complain of protrusion. The patient had an orthodontic treatment 10 years ago. However, the patient showed C III maloccusion with crowding, openbite and unilateral posterior crossbite on right side. In addition, the upper left central incisor had severe root resorption. Only 1/5 of root was remained. Considering the patient's chief complain, orthodontic treatment with extraction was needed. however, the upper left central incisor could not endure any orthodontic treatment. We decided to extract the short root incisor and 3 premolars to treat lip protrusion. After 30 months of orthodontic treatment, Class I molar relationships with proper overjet and overbite were achieved. The upper left lateral incisor replaced the left central incisor and restored as a central incisor with zirconia crown. Lip protrusion was alleviated.
Conclusion : Our result of this clinical report showed the successful protrusion treatment with extracting a central incisor and 3 premolars.

P-086

Decision making of extraction of third molars: orthodontic aspect

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Introduction : 93% human have third molars, and the most commonly impacted teeth in dentition. Not infrequently, it causes poor oral hygiene, dental caries, periodontal disease, inflammation, and malocclusion. It is controversial to need to extract third molars and extraction timing. We will suggest decision of extraction or not and the timing of extraction of third molar associated with orthodontic treatment.
Discussion : When orthodontists make a treatment plan, they have to consider the third molars (exist or not, degree of extraction difficulty, orthodontic needs to extract, and the occlusal relation with adjacent tooth). Orthodontic treatment plan affects decision of extraction or not and the timing of extraction of third molar. On the contrary, the degree of third molar extraction difficulty affects orthodontic treatment plan.
1. In case the position and eruption direction of a third molar affect position of second molar, we have to extract the third molar before leveling and alignment.
2. Third molar without extraction can be good substitution as second molar instead of missing or malposition second molar.
3. If third molar will be an obstacle due to the direction of orthodontic tooth movement as like molar distalization, we have to extract the third molar before retract molars. Inversely, in case of molar mesialization, it may be a better choice to postpone the third molar extraction after orthodontic treatment.
4. Even though extraction of a third molar is advantageous to orthodontic treatment plan, it is expected to contain high surgical difficulties accompanied by post-surgical risks. In this case, we need a reciprocal decision to change the orthodontic plan accordingly.
Conclusion : Orthodontic treatment plan affects decision of extraction of third molar or not and the timing of extraction. On the contrary, the degree of third molar extraction difficulty affects orthodontic treatment plan, so orthodontists have to discuss it with oral surgeons.

P-087

A prospective and cross-sectional cephalometric study on the interlabial gap and freeway space

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Introduction : The aim of this prospective study was to evaluate the cephalometric measurements at centric occlusion (CO) and rest position (RP) and their changes from CO to RP depending on the amount of interlabial gap (ILG) and freeway space (FWS). Lateral cephalograms and photographs of the included subjects (47 females, 57 males) were obtained at CO and RP. Cephalometric measurements at CO and RP and their differences were compared depending on the age, sex, ILG, and FWS.
Discussion : ILG ($P > 0.05$) and FWS ($P < 0.01$) were greater in males than in females. ILG ($P < 0.05$) and FWS ($P > 0.05$) were the greatest in adolescents. At CO, ILG increased as overjet ($P < 0.05$) and upper lip to esthetic line ($P < 0.01$) increased. At RP, ILG increased as upper incisor exposure and lips to esthetic line increased ($P < 0.001$), and FWS decreased as overbite decreased ($P < 0.001$). From CO to RP, lip length showed the greatest decrease ($P < 0.001$) in the large ILG group. From CO to RP, Bjork sum, mandibular plane angle, anterior facial height, and ANB ($P < 0.001$) showed the greatest increase, and OB ($P < 0.001$) showed the greatest decrease in the large FWS group. The lip competence group showed the largest distribution in the small ILG and FWS groups.
Conclusion : Taking cephalometric measurements at RP would be helpful to evaluate the ILG and FWS more accurately and to make a more predictable diagnosis and treatment plan.

P-088

Digital Workflow for Evaluation of Condylar Position Using Virtual Articulator

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Introduction : To perform an accurate evaluation of occlusion, the clinician must guide the mandible into a correct position. If there is an occlusal discrepancy between the maximum intercuspal position(MIP) and the centric relation occlusion(CRO) of the condyle, the condylar position must first be assessed. If the occlusion and TMJ are unstable, a splint therapy will be necessary before a definite orthodontic diagnosis and any active orthodontic treatment. A splint therapy helps stabilize the TMJ structure and confirm the true condylar position of the patient.
Discussion : The traditional analog articulator system and mandibular position indicator(MPI) used to confirm stability of the condyle during splint therapy can be complicated and cumbersome. Today's digital technology offers an alternative approach, and the following workflow can be adapted in the clinic.
1. Virtual mounting in MIP
- After matching CBCT & intraoral scan, virtual facebow transfer performed using digital articulator program.
2. Virtual mounting in CRO
- Mounting based on registration of mandibular model in CRO & maxillary model in MIP.
3. Evaluation of mandibular position
- Mandibular position evaluated in MIP & CRO with digital articulator program.
4. Digital tracing of condylar position
- Sequential condylar position & occlusion changes monitored with digital articulator program during splint therapy.
Conclusion : This presentation introduces a novel method of evaluating mandibular position before and after splint therapy with a virtual articulator, using a single CBCT image and successive intraoral scans.

P-089

Clinical application of maximum intercuspal position-centric relation occlusion conversion of a lateral cephalogram

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Introduction : Cephalometric radiographic x-rays with dental models have been used as standard diagnostic tools by orthodontic professionals since Broadbent's great achievement in the 1930s. Even though they can provide a substantial amount of information for planning orthodontic treatment, there have been questions whether they could offer a true relationship of the mandible to the patient's maxilla.
Discussion : There are often discrepancies in the mandibular position between the centric relation and maximum intercuspal positions (MIP), especially in patients with malocclusions. This condition appears as discrepancies between centric relation occlusion (CRO) and MIP at the occlusion level. When a patient shows a large MIP-CRO discrepancy, an orthodontic treatment plan must be reconsidered from the diagnostic stage. If a significant MIP-CRO discrepancy is found in the middle of orthodontic treatment, the patient's dental relation can be seriously altered, so finishing becomes complicated and the treatment period is prolonged. Diagnosis using an articulator-mounted model helps orthodontists establish an orthodontic treatment plan based on CRO. The quantitated condylar position obtained from an articulator can be transferred to a lateral cephalogram taken in MIP using a MIP-CRO conversion technique.
Conclusion : This poster will detail the step-by-step procedure with comprehensive illustrations for applying MIP-CRO conversion for diagnosis. The results of the MIP-CRO conversion provide a more accurate and predictable orthodontic treatment plan.

P-090

The applicability of lateral cephalometric measurement derived from cascade convolutional neural network to orthodontic diagnosis

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Objectives : The purpose of this pilot study is to evaluate the accuracy of orthodontic diagnosis derived from automated identification of lateral cephalometric landmarks.
Material and Methods : The dataset consisted of a total of 120 lateral cephalograms acquired from 120 patients of the department of orthodontics in Asan Medical Center, Seoul from 2019 to 2021. All patients aged > 18 years, who came for orthodontic treatment. Patients who had congenital dentofacial deformity and missing permanent first molars were excluded. Anatomic landmarks of the lateral cephalograms were identified by a second-year orthodontic resident(SYK). The cascade convolutional neural network(based on RetinaNet) was used for the landmark detection. Point-to point differences were calculated as the absolute distance value between the landmark identified by human examiner and AI. Lateral cephalometric variables were measured and angular, linear differences were compared. Orthodontic diagnosis were performed based on the cephalometric variables calculated and the results were also compared.
Results : The mean difference of landmark detection between the human examiner and the AI was 1.49±0.39mm. The mean detection difference for each landmark ranged between 0.49±0.0.3 mm (maxillary incisor crown tip) and 3.06±1.77 mm (Pterygoid). The mean linear difference of lateral cephalometric variables was 1.7±0.64mm and angular difference was 1.13±0.56 degrees. The mean accuracy of skeletal antero-postero, skeletal vertical orthodontic diagnosis based on the AI data compared to human examiner was 79%, 88% respectively.
Conclusion : The automated cephalometric landmark detection model may aid in preliminary screening for patient diagnosis and mid-treatment assessment, independent of the type of the radiography machines tested.

P-091

Classification and Characterization of Craniofacial Skeletal Phenotypes in Growing Patients with Nasal Airway Obstruction

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Objectives : The purpose of the study is to identify and characterize the craniofacial skeletal phenotypes of growing patients with nasal airway obstruction (NAO) using novel cluster analysis, clarifying the diversity of effects NAO has on craniofacial skeletal structures.
Material and Methods : Seventy-eight growing patients between ages seven and fifteen who were diagnosed as NAO by an otorhinolaryngologist and had performed adenotonsillectomy with/without turbinoplasty were included in the sample. Before adenotonsillectomy, subjects took lateral cephalograms for orthodontic diagnosis. All cephalometric data were standardized, excluding the effects of age and gender. Through exploratory data analysis, twenty-two cephalometric variables were chosen for the following analyses. Principal component analysis was used for dimension reduction and selection of cluster variables. After choosing the number of clusters, cluster analysis was performed by Gaussian mixture model. All identified clusters were visualized by t-distributed stochastic neighbor embedding. Each cluster was characterized by descriptive and variance analysis of standard scores.
Results : Two clusters were identified according to craniofacial skeletal pattern and clarified on the visualization model. Both clusters exhibited maxillary retrusion, hyperdivergent pattern and large distance from menton to L1 (Me-L1). In anteroposterior relationship, cluster 1 exhibited skeletal class III pattern, concave profile, chin protrusion, long mandibular body length and small incisor overjet, whereas cluster 2 showed skeletal class II pattern, convex profile, chin retrusion, normal mandibular body length, large incisor overjet and small interincisal angle. In vertical relationship, cluster 1 exhibited large maxillary vertical growth, long ramus height, whereas cluster 2 showed small maxillary vertical growth, large lower facial height, and larger Me-L1 than cluster 1.
Conclusion : Two phenotypes of growing patients with NAO shown in this study clarifies the diversity of effects NAO has on craniofacial skeletal growth. This finding can be a great stepping stone toward advanced diagnosis and treatment planning in orthodontics for growing patients with NAO.

P-092

Characterization of Phenotypes and Treatment Modalities in Patients With Treacher-Collins Syndrome

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Objectives : The purpose of this study was to investigate the phenotypes and treatment modalities (Tx-Mod) in patients with Treacher-Collins syndrome (TCS) using a TCS severity index (TSI).
Material and Methods : The sample consisted of 14 Korean TCS patients treated at the Department of Orthodontics, Seoul National University Dental Hospital during 1998 to 2019. The TSI was calculated by adding the scores from the number of deformity-involved midface structures (eye, ear, zygoma) and the degree of mandibular hypoplasia (Pruzansky-Kaban type, gonial angle, Sella-Nasion-B point angle). The deformity-involved midface structure, degree of mandibular hypoplasia, oral manifestations, dental phenotypes, and Tx-Mod types were investigated using descriptive statistics.
Results : The TSI classified the subjects into 2 mild, 6 moderate, and 6 severe cases. The severity of ear and zygoma deformities, degree of condylar hypoplasia (Pruzansky-Kaban type), clockwise-rotated morphology (gonial angle) and retrusive position (Sella-Nasion-B point angle) of the mandible, and frequency of oral/ craniofacial cleft, openbite, congenitally missing tooth and impacted tooth showed a tendency of increase from mild to severe TCS cases. After growth observation (78.6%), diverse combinations of Tx-Mods were applied except for functional appliance therapy. Surgical procedures for eye, ear, and zygoma reconstruction were performed on all patients (100%), whereas fixed orthodontic treatment, mandibular distraction osteogenesis, and orthognathic surgery were performed on 50% of patients. Surgical procedure for hearing improvement was the most frequent Tx-Mod (78.6%).
Conclusion : The main desires of TCS patientswere to obtain the facial esthetics in the midface and to improve hearing function. The TSI might provide a primary data for individualized diagnosis and treatment planning.

P-093

Comparison between 2D Radiographs and CBCT Images in Detecting of Incidental Findings in Orthodontic Patients.

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Objectives : The purpose of this study was to investigate the rates of incidental findings (IFs) of craniofacial diseases or abnormal structures without any symptoms using 3D CBCT images that were taken for orthodontic diagnosis, and to compare the detecting ability of 2D radiographs to that of 3D CBCT images.
Material and Methods : 1,020 patients who took CBCT for orthodontic treatment without any craniofacial symptoms were selected. CBCT images were taken with C-mode that covers the craniofacial area with large field of view. The areas of IFs were classified into five categories: maxillary sinus, TMJ, nasal cavity, soft tissue calcification, and pathology. The sensitivity, specificity, positive predictive value, and negative predictive value were analyzed statistically for evaluating the effectiveness and accuracy of 2D radiographs in detecting IFs compared to 3D CBCT images which are considered to be a gold standard.
Results : At least one IF was found in 709 subjects (69.5%) of 1,020 patients, and 16 hard tissue pathologies (1.6%) were detected in CBCT. Nasal cavity was the most affected area. The accuracy of detecting IFs identical to those of CBCT in 2D radiographic images was found to be 50.0% to 85.7%. The highest accuracy in detecting the IFs of soft tissue calcification, moderate accuracy for IFs of the maxillary sinus, TMJ, and pathology, and low accuracy for IFs of the nasal cavity were detected. The combination of 2D radiographs for detecting Ifs with high accuracy were found according to the areas.
Conclusion : Although some of 2D radiographs showed relatively high accuracy on detecting IFs, 3D CBCT guarantees even more precise detection. Clinicians should investigate radiographic images carefully because considerable IFs can be interpreted in orthodontic patients.

P-094

Multistage Convolutional Neural Network-based Automated Landmark Identification System On CBCT Synthesized Images

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Objectives : The purpose of this study was to evaluate the feasibility of automated landmark identification systems using lateral and PA cephalograms synthesized by cone-beam computed tomography(CBCT).
Material and Methods : CBCT images of 430 patients who visited Kyunghee University Dental Hospital were studied as subjects, and images for deep learning were prepared using 3D image viewer program. An operator performed manual identification to complete image preprocessing for supervision. Overall learning was carried out on synthetic lateral and posterioanterior cephalograms, respectively. Next, training was carried out by cropping the image including the measurement point in the convolution model consisting of five steps. The prediction accuracy of artificial intelligence was evaluated by mean radial error and successful detection rate (%).
Results : As a result of convolutional deep learning with a multi-level structure, it showed relatively high prediction accuracy with an average MRE of 1.09mm in the CBCT synthetic lateral cephalogram group. Among them, Nasion showed the highest prediction accuracy of 0.45mm, and Gonion showed the lowest prediction accuracy value of 2.25mm. The average MRE of 2.23 mm was relatively low in the CBCT synthetic posterioanterior cephalogram group. At the Alveolar crest point, showed the highest prediction accuracy of 1.03 mm and 1.20 mm within the group. The Condylion showed the lowest prediction accuracy of 4 mm or more.
Conclusion : The convolutional deep learning model with multi-level structure seems to be able to predict the accuracy within the clinically applicable range for CBCT synthesized cephalograms.

P-095

Automated Identification of Cephalometric Landmarks for Upper Airway Analysis Using Cascaded Convolutional Neural Networks

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Objectives : The aim of the study was to evaluate the accuracy of a cascaded two-stage convolutional neural network (CNN) model in detecting upper airway (UA) soft tissue landmarks in comparison with the skeletal landmarks on the lateral cephalometric images.
Material and Methods : 600 lateral cephalograms of adult orthodontic patients were included and randomly allocated into 428 training, 72 validation, and 100 test datasets. The ground-truth positions of 16 landmarks (7 skeletal and 9 UA landmarks) were obtained from one expert's digitization using a software. A UNet with EfficientNetB0 model was trained through the region of interest-centered circular segmentation labeling process. Mean distance errors (MDEs, mm) of the CNN algorithm was compared with intraexaminer variability between one expert's repeated trials and with interexaminer variability among three experienced orthodontists. Successful detection rates (SDRs, %) assessed within 1-, 2-, -3, and 4-mm precision ranges were compared between skeletal and UA landmarks.
Results : The proposed model achieved lower accuracy in detecting UA landmarks (MDE of 1.78 ± 1.21 mm) than skeletal landmarks (0.80 ± 0.55 mm) on average. The mean SDRs for skeletal and UA landmarks were 93.43% and 72.22%, respectively, for clinically acceptable 2-mm precision range. However, large variations were found in the MDEs and SDRs within UA landmarks. Geometrically constructed UA landmarks (AD1, AD2, Ss) showed high detection accuracy by CNN algorithm, while anatomically located UA landmarks on the tongue (Td) and soft palate (Sb, St) showed low accuracy when compared with interexaminer variability.
Conclusion : The time-consuming human labors could be efficiently substituted by artificial intelligence (AI) for dimensional analysis of UA, although positional analysis of tongue and soft palate remains challenging both for AI and humans. The proposed CNN model suggests the availability of an automated cephalometric UA assessment to be integrated with dentoskeletal and facial analysis.

P-096

Three-dimensional displacement pattern of facial surface landmarks at smile depending on lip protrusion

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Objectives : The aims were to evaluate 3D movement and relative protrusion of facial surface landmarks at smile depending on lip protrusion and to make the reference plane for evaluation of lip position in 3D analysis.
Material and Methods : This study included 26 ㄴ Class I adult patients. They were divided into two groups by degree of the lip protrusion relative to Ricketts' E-line: non-protrusion group (group N; 9 males, 7 females; mean age, 25.1 ± 4.2 years), protrusion group (group P; 7 males, 3 females; mean age, 24.8 ± 8.5 years). After markers were attached on facial surface landmarks, the subject's face was scanned at rest and at smile. Absolute and relative protrusions were calculated at rest and at smile. The measurements were compared between the two groups, and the correlation between absolute protrusion and relative protrusion was examined.
Results : 1. Zygomatic points moved to lateral-superior direction at smile, and cheek points moved laterally, superiorly and anteriorly. Subnasale, labrale superius moved superiorly and posteriorly, and labrale inferius, soft tissue B, soft tissue pogonion moved inferiorly and posteriorly. Cheilion, nasolabial fold moved laterally, superiorly and posteriorly.2. There was no significant difference of the amount of 3D displacement at smile between group N and group P ($P > 0.05$).3. Group P had significantly more protrusive lip to the reference plane than group N at rest and at smile ($P < 0.05$).
4. There was no significant difference of the change of absolute and relative protrusion at smile between group N and group P ($P > 0.05$).
Conclusion : Based on this study, it is considered that the 3D displacement pattern of facial soft tissue at smile is almost identical with or without lip protrusion. The plane including bilateral midface point and soft tissue pogonion can be used the reference plane for evaluation of relative lip protrusion in 3D analysis.

P-097

Accuracy of Automated Identification of Posteroanterior Cephalometric Landmarks Using a Deep Learning Method

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Objectives : To investigate the accuracy of auto-identification of the posteroanterior (PA) cephalometric landmarks using cascade convolution neural network (CNN) algorithm and PA cephalogram images with different quality from nationwide multi-centers.
Material and Methods : Among 2,798 PA cephalograms from 9 university hospitals, 2,418 images (2,075 training-set and 343 internal validation-set) were used to train the CNN algorithm for auto-identification of 16 PA cephalometric landmarks. Then, 99 pretreatment images of the remaining 380 test set images were used to investigate the accuracy of auto-identification of the CNN algorithm by comparison with human examiner (gold standard) using V-Ceph 8.0 (Ostem, Seoul, Korea). Pretreatment images were used to eliminate the effects of orthodontic bracket, tube and wire, surgical plate and surgical screws. Paired t-test was performed to compare the x- and y-coordinates of each landmark. The point-to-point error and the successful detection rate (SDR; range, within 2.0 mm) were calculated.
Results : The numbers of landmarks without significant difference in location between human examiner and auto-identification were 8 on the x-coordinate and 5 on the y-coordinate, respectively. The mean point-to-point error value was 1.52 mm. The high point-to-point error (more than 2.0 mm) was observed at the right maxillary first molar root apex (2.18 mm) and the lower one (less than 1.0 mm) were observed at the left and right antegonion (0.96 mm and 0.99 mm, respectively). The mean SDR of auto-identification was 83.3%.
Conclusion : Cascade CNN algorithm for auto-identification of PA cephalometric landmarks showed a possibility of an effective alternative to manual identification.

P-098

A Study on the Changes of BMD around Posterior Teeth before and after Orthodontic Treatment

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Objectives : The purpose of this study was to investigate the changes in bone mineral density of the posterior teeth before and after orthodontic treatment.
Material and Methods : 9 healthy female patients in their twenties were selected who had orthodontic treatment with premolar extractions. Patient with congenital developmental abnormalities, facial deformities, and systemic diseases were excluded from the study. Bone mineral density of the buccal cortical bone of the maxillary first and mandibular first molars, the trabecular bone between the roots, the lingual cortical bone, and the palatal cortical bone were measured from the CBCT data of the subjects before orthodontic treatment, after orthodontic treatment. Bone mineral density was evaluated by the Hounsfield Unit (HU) value on the CBCT. The non-tooth bearing areas A-point and Gn., and HU values of the maxillary central incisor and mandibular central incisors were measured and compared with those of the posterior alveolar bone.
Results : At most measurement points, HU decreased slightly after treatment, but no statistical significance was observed. The cancellous bone between the root of the mandibular first molar had increased HU after orthodontic treatment. The HU of the cancellous bone of the root furcarion was lower than that of the buccal cortical bone. In the maxilla, HU was highest in the order of buccal cortical bone, palatal cortical bone, and root furcation cancellous bone. In the mandible, HU was highest in the order of lingual cortical bone, buccal cortical bone, and root furcation cancellous bone.
Conclusion : In this study, there was no statistically significant difference in bone density of alveolar bone in the posterior region before and after orthodontic treatment with tooth extraction.

P-099

Comparison of Cephalometric Analysis among Two Artificial Intelligence and a Conventional Manual Programs

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Objectives : Cephalometric analysis program is essential tool for diagnosis, decision of treatment plan, and evaluation in orthodontic treatment. The purpose of the present study was to compare the results of two automatic cephalometric program based on artificial intelligence technology with those acquired with conventional cephalometric analysis.
Material and Methods : Lateral cephalograms of 20 orthodontic patients (10 males, 10 females, mean age 25.8) were included and the cephalometric measurements were obtained from the two artificial intelligence program (AI-1 and AI-2) and conventional program. 9 skeletal measurements, 8 dental measurements and 2 soft tissue measurements obtained from two methods were compared using ANOVA and Tukey.
Results : In the comparison between the automatic and conventional cephalometric analysis, some measurements regarding skeletal structure and tooth structure showed statistically significant differences.
Several cephalometric measurement differences can be occurred by following reasons. 1) AI methods can not detect superimposed anatomical structures and landmarks precisely. 2) Difference of the anatomical location in each individuals make some errors. 3) In clinical practice, cephalometric analysis using the AI program performs automatic analysis with manual adjustment by the clinician. However, in this study, manual adjustment was not performed in order to evaluate the performance of the AI program.

Conclusion : Automatic cephalometric analysis based on artificial intelligence technology might offer the clinically acceptable diagnostic performance with manual adjustment.

P-100

Prediction of Maxillary Canine Impaction Using Eruption Pathway and Angular Measurement on Panoramic Radiographs

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Objectives : To compare the normal eruption pattern and angulation in an impacted maxillary canine using panoramic radiographs to predict maxillary canine impaction.
Material and Methods : Patients aged 6–15 years were classified into the normal eruption group (n = 229) and the impaction group (n = 191). At least two panoramic radiographs were taken in the normal eruption group during the eruption process of the maxillary canine. The growth pattern of the maxillary canine was analyzed using an XY coordinate system, with the tip of the maxillary lateral incisor as the origin and the tooth's long axis as the Y-axis, and the measurement of the relative position of the crown tip and angulation of the maxillary canine.
Results : The crown tip of the normal erupted maxillary canine was intensively distributed along the distal surface of the maxillary lateral incisor, while that of the impacted canine was widely distributed. The angulation of the normal erupted canine increased as the eruption increased along the lateral incisor and then decreased at the cervical point of the lateral incisor. The angulation of the impacted canine was scattered with no uniform pattern.
Conclusion : While using the normal eruption path of the maxillary canine and the pattern of change in the angulation based on the distal surface of the maxillary lateral incisor, early intervention or a regular follow-up is needed to prevent maxillary canine impaction.

P-101

Evaluation of changes of alveolar bone density around anterior teeth before and after orthodontic treatment

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Objectives : The purpose of this study was to compare the bone mineral density of the alveolar bone around anterior teeth before and after orthodontic treatment in young adult patients.
Material and Methods : 9 healthy adult female patients (mean age 21.9 years) who were treated at the Department of Orthodontics, Seoul St.Mary's Hospital, The Catholic University of Korea were selected for this study. The inclusion criteria were periodontally healthy patients who had been treated with 4 premolar extractions. Patients with more than 3 mm of crowding in the anterior teeth, missing teeth, and apical lesion or restoration of anterior teeth were excluded. Also, patients with medical problems were excluded. Bone mineral density of the alveolar bone around anterior teeth was evaluated by measuring the Hounsfield Unit(HU) of the pre and posttreatment cone-beam computed tomography (CBCT) images. The labial cortical bone, trabecular bone, and lingual cortical bones around the maxillary right central incisors and mandibular right central incisors were measured. The non-tooth bearing areas including A-point, Gnathion and incisal edge of central incisor.
Results : The alveolar bone density around anterior teeth before and after orthodontic treatment did not show statistically significant differences except A point area. Mean values of HU measured at A point (603.6 at pre vs. 542.7 at post, P = .039) decreased significantly after treatment. The bone density of the maxillary labial cortical bone, lingual trabecular bone, and A was similar; however, lingual cortical bone of the maxillary central incisor was higher. In the mandibular bone, the bone density around Gn was highest, followed by lingual cortical bone and trabecular bone around the apex of the central incisal.
Conclusion : This study demonstrated that there were no statistically significant changes in the bone density after orthodontic treatment except A point. Orthodontic treatment did not result in the changes of bone density in the tooth-bearing alveolar bones.

P-102

Factors influencing lower lip profile during skeletal Class III camouflage treatment

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Objectives : The study aims to find the factor with influences lower lip profile during Class III camouflage treatment.
Material and Methods : The cohort included 50 patients (male: 17, female: 33, mean age 26.8 years) diagnosed with skeletal Class III malocclusion. These patients underwent camouflage orthodontic treatment with lower arch total distalization. Lateral cephalograms at the pre-treatment stage and post-treatment stage were taken. Cephalometric measurements were analyzed to uncover the influencing factors of lower lip profile.
Results : Novel soft tissue measurements presented in this study(CK angle, CKH angle) showed statistically significant change after treatment. CK angle and L1 to A Pog, L1 to NB, Wits, IMPA, APDI were statistically correlated. Simple regression analysis was conducted between CK angle and L1 to APog, L1 to NB. The formulas were ΔCK angle = 0.301(Δ L1 to A Pog) – 0.930, ΔCK angle = 0.955(Δ L1 to NB) + 0.634, and multiple regression resulted in ΔCK angle = 0.291(Δ L1 to A Pog) – 0.160(ΔWits) – 1.17, ΔCK angle = 0.955(ΔL1 to NB) - 0.326(ΔWits) + 0.232.
Conclusion : The present study provides evidence that CK(H) angle, novel soft tissue measurements are significantly correlated to mandibular incisal position during total distalization of the mandibular dentition. Therefore, non-extraction with distalization must be considered the first treatment option in mild skeletal class III malocclusion patients.

P-103

Relationship of the craniofacial morphology with electromyographic activity of masticatory muscle and occlusal force

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Objectives : This study was performed to investigate the effect of the craniofacial morphology on the electromyographic activity of masticatory muscle and the occlusal force. This study was also performed to investigate the correlation between the occlusal force and the electromyographic activity of masticatory muscle.
Material and Methods : Forty subjects whose orthodontic treatment had finished more than 2 years were enrolled, and bite force examination and electromyography (EMG) of the anterior temporalis and superficial masseter were performed. A lateral cephalogram previously taken were used to analyze craniofacial morphology. The relationship among the craniofacial morphology, bite force, and EMG were evaluated with correlation analysis.
Results : There was statistically significant positive correlation between bite force/occlusal contact area ratio and maximum voluntary contraction (MVC) of the anterior temporalis. The low-angle craniofacial morphology such as low gonial angle, high facial height ratio, and low mandibular plane angle showed statistically positive correlations with bite force, occlusal contact area, or bite force/occlusal contact area ratio. However, other cephalometric parameters did not show significant correlations with MVC of the masticatory muscles. It would need further study to know about the correct correalation.
Conclusion : Craniofacial morphology seems to have direct correlation with bite force but indirect correlation with MVC of the anterior temporalis muscle rather than the masseter muscle.

P-104

Heritability of Maxillary Dental Cephalometric Variables of Monozygotic twins, dizygotic twins and siblings

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Objectives : The genetic comparison of craniofacial variables through twin studies has been important in orthodontics and has clinical significance. In this study, heritability of maxillary central incisor, canine, first molar was measured.
Material and Methods : The subjects were consisted of 36 pairs of monozygotic twins (16 pairs of males and 20 pairs of females), 13 pairs of dizygotic twins (7 pairs of males and 6 pairs of females) and 26 siblings (11 pairs of males and 15 pairs of females) who visited Samsung Medical Center, Seoul, and had lateral cephalometric images. All patients are over 20 years old and the average age is 39.75 years. Linear variables of each tooth (6 vertical, 6 horizontal) and 3 tooth axis variables were measured. Intraclass correlation coefficient(ICC) of each group was calculated and heritability(h2) was calculated by using falconer's method.
Results : Monozygotic twin group intraclass correlation coefficient(ICC) of 6 vertical linear variables of 3 teeth(mean 0.837, $P<0.001$) and axis variables of upper central incisor and canine(mean 0.679, $P<0.001$) were higher than ICC of dizygotic twin group and siblings. Heretability of these variables showed significantly high value.
Conclusion : Orthodontic treatment changing vertical variables of maxillary teeth and the axis of maxillary central incisor and canine which showed high heritability can be more difficult. Therefore It is necessary to establish a strategic treatment plan considering long term stability.

P-105

Root Elongation via Intentional Vertical Eruption of Immature Impacted Tooth

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Introduction : Delay in root development is found frequently in the immature impacted teeth, and a spontaneous root elongation is hard to take place only with the periodic observation. However, providing an environment that may enable the apical papillary stem cells(SCAP) to initiate root formation, such as intentional repositioning of adjacent teeth or vertical traction of impacted teeth, can result in a successful eruption of impacted teeth with favorable root elongation as well.
Discussion : We introduce four cases with the immature impacted tooth with Nolla's developmental stage of 5-7 contrasted by the counter-part mature teeth. Each case had a horizontally impacted maxillary right central incisor, impacted mandibular left first premolar, delayed eruption of mandibular right second molar, and impacted maxillary left second premolar.
In three cases, the impacted or delayed erupted teeth were treated with a methodology of active vertical traction. Along with the successful eruption of the teeth, the sufficient elongation of roots to a degree of development comparable to that of the contralateral teeth were also observed. In the fourth case, after space regaining through intentional repositioning of adjacent teeth to secure a sufficient space for eruption, spontaneous movement of the impacted tooth with root elongation was observed.
Conclusion : Through guiding the eruption of impacted teeth, the immature roots were successfully developed from the Nolla's developmental stage of 5-7 in the initial stage to 9-10 after the treatment, showing a difference of 3.5 ± 0.5 stage on average. Also, the tooth length ratio, estimated by dividing impacted tooth length by adjacent or contralateral tooth length, increased by 0.27 ± 0.07. Therefore, active orthodontic interventions such as vertical traction or intentional repositioning of adjacent teeth should be considered for the favorable development and prognosis of impacted teeth rather than conservative periodic observation.

P-106

Effect of Orthodontic Treatment to Physical Growth Based on Korea School Health Examination Survey

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Objectives : Orthodontic treatment is often performed during the growth period and takes a relatively long treatment period. Furthermore, there may be discomfort in food intake to varying degrees during orthodontic treatment. Some parents and patients hesitate to undergo orthodontic treatment during the growth period because they suspect that orthodontic treatment negatively impacts children's physical growth. The objective of this retrospective study is to evaluate the effect of orthodontic treatment on physical growth (height, weight, and BMI) of children and adolescents using a nationwide school health survey.
Material and Methods : Raw data for this study were obtained from the Korea School Health Examination in 2018 and 2019. Sample data of 1st grade(E1) and 4th grade(E4) of elementary school students, 1st grade of middle school students(M1), and 1st grade of high school students(H1) were included for this study. These grades visited medical institutions and performed health examinations, including oral examinations performed by qualifying dentists. The student's occlusion was recorded into three groups; normal occlusion, orthodontic treatment needed (NT), and under orthodontic treatment (UT). The normal occlusion group was excluded because it was not possible to confirm whether or not they had experienced orthodontic treatment. The height, weight, and BMI were compared between the NT and UT groups by gender and grade.
Results : For both male and female, the number of children/adolescents undergoing orthodontic treatment increased with grade level. There was no significant difference in the height between the NT and UT groups in all genders and grades ($P>0.05$). In the weight, female H1, male E4 and M1 showed significantly larger values in the UT group. In the BMI, female H1, male E4 and H1 show significantly larger values in the UT group.
Conclusion : In conclusion, orthodontic treatment does not negatively affect the physical growth of children/adolescents.

P-107

Prevalence and Pattern of Dental Anomalies according to the Malocclusion Type in Korean Orthodontic Patients

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Objectives : The purpose of this study was to investigate the prevalence and pattern of dental anomalies in Korean orthodontic population and compare them according to skeletal malocclusion type.
Material and Methods : A total of 3240 orthodontic patients (22.2 ± 11.6 years) were evaluated and classified as Class I (n = 632), Class II (n = 1178), or Class III (n = 1430) malocclusion group according to ANB angle. The presence and location of the four most common dental anomalies; tooth impaction, microdontia, tooth agenesis, and supernumerary tooth, were identified through examination of their initial diagnostic records.
Results : Tooth impaction (8.6%) was the most prevalent dental anomaly, followed by microdontia (6.8%), tooth agenesis (6.5%), and supernumerary tooth (2.2%) in the total sample. Class I and Class III group showed the same order of prevalence, but tooth agenesis (8.1%) was more frequent than microdontia (6.9%) in Class II group. The maxillary and mandibular distribution of dental anomalies, except for microdontia, was different according to malocclusion type. In the total sample, the maxillary canine was the most impacted tooth and the majority of microdontia was the maxillary lateral incisor. The mandibular incisor was the most frequently missing tooth, while supernumerary tooth mostly occurred mostly in the premaxilla region. The prevalence of all four dental anomalies was higher in Class I (23.4%) or Class II (21.4%), than in Class III (17.3%) malocclusion.
Conclusion : The prevalence and pattern of dental anomalies varied depending on the type of malocclusion. The overall prevalence of the four common dental anomalies was lower in Class III than in Class I or II malocclusion.

P-108

Evaluation of Craniofacial Morphology in Female Central Precocious Puberty Patient Before and After Growth Completion

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Objectives : The purpose of this study was to evaluate the craniofacial morphology of patients with central precocious puberty by analyzing lateral cephalograms before and after growth completion.
Material and Methods : This study included 15 Korean girls (mean age, 10.2 ± 2.0 years) who have been diagnosed with central precocious puberty (CPP) and treated with medication. The reference group consisted of 19 Korean girls (mean age, 10.2 ± 1.9 years) with no specific medical history and a chronological age similar to the CPP group. Both groups received orthodontic treatment and ended treatment after growth was complete. Completion of growth was confirmed through hand-wrist radiographs. The craniofacial morphology was evaluated by analyzing the lateral cephalometric radiographs at the start of treatment (T0) and the end of treatment (T1). Total treatment time (T1-T0) of CPP group (69.0 ± 18.5 months) is similar (P = 0.751) to reference group (71.2 ± 20.3 months).
Results : At the start of treatment (T0), the Björk sum (399.2 ± 4.7°) and lower gonial angle (77.7 ± 3.4°), SN to GoMe (39.2 ± 4.7°) (P < 0.05) were greater and the facial height ratio (61.5 ± 3.1; P= .015) was lesser in the CPP group than in the reference group. At the end of treatment (T1), the Björk sum (400.1 ± 5.8°) and gonial angle (123.6 ± 4.4°), lower gonial angle (79.0 ± 4.2°), SN to GoMe (40.1 ± 5.8°) (P < 0.05) were greater and the facial height ratio (61.5 ± 3.4; P= .021) was lesser in the CPP group than in the reference group.
Conclusion : A young girl with CPP maintained a vertical pattern at the start of treatment after the end of growth despite orthodontic intervention.

P-109

A Study on Chin's Skin Response in Class III Children Treated with FaceMask

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Objectives : There are various orthodontic devices to improve skeletal anterior crossbite. Among these devices, the chin skin reaction of children treated with a class III face mask will be investigated.
Material and Methods : In 111 children treated with face mask at an orthodontic clinic, the skin reaction level of the chin was evaluated through the Skin Irritation Index and related factors were evaluated.
Results : Among all the patients, 45.9% of the patients showed chin skin irritation, of which 54.9% responded within 1 month, and no chin skin symptoms occurred after 4 months. As for the degree of skin reaction, redness was 37.8% and ulcers or lacerations were 8.1%. As a result of evaluating the factors related to the chin skin reaction, there was no correlation between age, sex, and severity of OJ and OB, and all cases with the occurrence of temporomandibular joint symptoms showed a chin skin reaction ($x2 = 10.143$, $p < .001$).
Conclusion : 45.9% of patients treated with a face mask show a chin skin reaction, and most of the chin symptoms occur within 4 months of setup of face mask. If necessary, we consider the application of a customized chin cup that fits the patient's chin shape.Prior to the start of facemask treatment, it is necessary to notify the patient and parents about the possibility of temporomandibular joint symptoms and side effects that may occur on the skin of the chin and forehead, and treatment must be started with informed consent

P-110

Differences In Heritability Of The Skeletodental Characteristics Between Skeletal Class I And II Subjects

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Objectives : To investigate differences in the heritability of skeletodental characteristics between skeletal Class I and Class II twin pairs.
Material and Methods : Forty Korean adult twin pairs were divided into Class I group (0°≤ANB≤4°; mean age, 40.7 years-old) and Class II group (ANB>4°; mean age, 43.0 years-old). Each group comprised 14 monozygotic and 6 dizygotic pairs. 33 cephalometric variables were measured using lateral cephalograms. Craniofacial structures were divided into the anteroposterior, vertical, dental, mandible, and cranial base characteristics. The ACE model was used to calculate heritability (A>0.7 indicates high heritability). Then, principal components analysis (PCA) was performed.
Results : In the anteroposterior characteristics, high A values were observed for numerous variables in Class I group and for SNB and facial angle in Class II group. In the vertical characteristics, high A values were observed for FH-PP and PP-MP in Class I group and PP-MP, anterior and posterior facial height in Class II group. In the dental characteristics, high A values were observed only in Class I group. In the mandibular characteristics, CD-Gn and Ar-Go showed high A values in Class II group. The cranial base length variables (S-N, S-Ar, Ar-N) showed high A values in Class II group. The PCA demonstrated that Class I and Class II groups derived eight components with 88.3% cumulative explanation and seven components with 91.0% cumulative explanation, respectively.
Conclusion : These results provide valuable information for growth prediction and planning of orthodontic and/or orthopedic treatment for Class I and Class II patients.

P-111

PRE-IMPLANTATION AND POST-ORTHODONTIC TREATMENT USING DIGITAL DENTISTRY IN PATIENTS WITH MULTIPLE MISSING TEETH

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Introduction : Patients who have lost multiple teeth have irregular dentition due to the extrusion of the opposing teeth and the inclination of adjacent teeth. And these patients need various dental multidisciplinary treatments such as orthodontics and prosthetics.
The traditional method for these patients is to perform orthodontic treatment arranging the remaining teeth first and then place implants in the edentulous area later.
But our team had made accurate treatment plan with digital 3D teeth set-up, implants were placed in accurate position first and then the orthodontic treatment was performed later.
Discussion : If only a few teeth remain, it is difficult to get an orthodontic anchorage, patient's mastication is difficult and the vertical dimension becomes deeper during the orthodontic treatment. It may be helpful to place implants first and then start orthodontic treatment, but implants that are placed in incorrect positions can interfere with orthodontic movement and distort the results, so it can be a big problem.
Therefore, our team planned the exact direction and amount of tooth movement through accurate digital 3D teeth set-up. And we planned the design of the implant prosthesis through digital 3D wax-up, and then 3D printed the implant surgical stent.
After immediate or short-term healing of implant surgery, temporary crowns were fabricated in the form of a 3D waxed up prosthesis, mounted and then the orthodontic treatment was performed.
After orthodontic treatment, final prostheses were placed.
Conclusion : Through diagnosis and treatment using digital dentistry, patients with multiple missing teeth could be treated effectively.
In particular, implant temporary crowns in the shape of the final prosthesis can be used as an absolute anchor for the orthodontic teeth movement. They can also quickly recover the patient's masticatory ability, maintain vertical dimension, and enable successful multidisciplinary treatment.

P-112

How do the effects of MARPE and its association to corticopuncture distinguish from conventional RPE?

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Purpose : This study aimed to evaluate the skeletal and dentoalveolar effects of rapid maxillary expansion using cone-beam computed tomography (CBCT) in four groups: conventional tooth-borne rapid maxillary expansion with Haas expander (ERM), mini-implant-assisted rapid palatal expansion (MARPE), MARPE with corticopuncture (midpalatal suture perforations) (MARPE+CP) and MARPE failure cases (MARPE failure).
Materials and methods : CBCT's of 40 patients were performed before (T1) and after (T2) treatment. Skeletal and dentoalveolar changes were evaluated through linear and angular measurements using the Horos v3.3.5 software.
Results : The MARPE+CP group showed no statistically significant difference ($p>0.05$) concerning alveolar bone height in the premolar region and the MARPE and MARPE+CP groups concerning molars, comparing T1 and T2. The ERM group had the greatest vertical bone loss with a statistical difference between the other groups in the premolar region. As for bone thickness in the most coronal region, in the premolar region, all groups showed a bone loss, and in the molar region, only the MARPE and MARPE+CP groups showed no significant differences after the intervention. Concerning the most apical bone thickness, the ERM and MARPE failure groups showed a significant bone reduction, while the MARPE and MARPE+CP groups did not show bone alterations in the premolar and molar regions. All groups suffered a slight root shortening.
Conclusions : MARPE with or without corticopuncture, minimizes the side effects of conventional tooth-borne rapid expansion, generating greater skeletal effects.

P-113

Craniofacial Changes Affecting Respiratory Improvement After Nasomaxillary Expansion in Pediatric Obstructive Sleep Apnea Patients

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Objectives : The aim of this study was to investigate the correlation of three-dimensional changes in nasomaxillary complex (NMC) and upper airway (UA) compartments after nasomaxillary skeletal expansion (NMSE) with functional changes in respiration and sleep in pediatric obstructive sleep apnea (OSA) patients.
Material and Methods : Twenty-six nonobese OSA patients (mean age, 13.59±2.90 years; mean body mass index, 18.09±3.00 kg/m2); mean apnea-hypopnea index (AHI), 7.04±5.40 events/h) presenting with transverse nasomaxillary constriction were evaluated before and after NMSE using cone-beam computed tomography (CBCT), home sleep test (HST), and modified pediatric sleep questionnaire (m-PSQ). Paired t-tests were performed to examine the treatment changes of all parameters, and a multiple regression analysis, adjusted for age and sagittal and vertical skeletal patterns, was conducted to determine the dimensional parameters to affect the functional improvement.
Results : NMSE treatment significantly increased NMC dimensions at all tested levels and all UA compartments in CBCT, except glossopharyngeal airway. Concurrently, AHI, oxygen desaturation index (ODI), the lowest oxygen saturation (LSaO2), flow limitation (FL), snoring, and m-PSQ were significantly improved. AHI reduction was correlated with UA enlargement with no correlation with NMC expansion, whereas FL reduction was affected by NMC expansion. The minimal cross-sectional area (MCA) was the most predictive of functional improvement, presenting correlations with AHI, LSaO2 and m-PSQ.
Conclusion : NMSE can be a primary treatment for nonobese pediatric OSA patients with nasal obstruction when designed to ultimately improve pharyngeal collapsibility as well as nasal airflow, beyond the dimensional increase of NMC. In addition, combined treatment with NMSE should be considered for the complicated patients to prevent and interrupt the secondary craniofacial deformation to OSA.

P-114

Comparison of Intra-alveolar Movement of Tooth Germs After Maxillary Protraction Between Tooth-borne and Skeletal Anchorages

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Objectives : The purpose of this study was to investigate the difference of maxillary intra-alveolar tooth germ movement after maxillary protraction treatment between patients who received maxillary protraction treatment with rapid maxillary expansion (RME) and miniplate anchorage.
Material and Methods : Seventeen Class III patients who received maxillary protraction treatment with RME (RME group, mean age 8.8±1.1) and 5 Class III patients with miniplate (miniplate group, mean age 10.2±2.0) were included in this retrospective study. The dentoskeletal changes, including movement of the maxillary second premolar and second molar tooth germs, between pre-treatment (T1) and after the treatment (T2) were evaluated using lateral cephalograms. For the measurement, X-Y coordinate system was used, and the horizontal axis was drawn by rotating the sella-nasion line 6° downward at the point sella, and the vertical axis was defined as the line perpendicular to the horizontal axis and passing through the point sella. The net tooth germ movement was measured by subtracting the amount of A-point movement from the tooth germ movement. The cephalometric changes between the groups were compared by the statistical method (Mann-Whitney U test).
Results : The RME group showed lesser increase of lower anterior facial height, and lesser advancement of A-point than miniplate group for skeletal measurements after the treatment. For dental measurements, RME group showed greater proclination and advancement of maxillary incisor, greater increase of incisor overjet, lesser increase of overbite, and greater advancement of maxillary first molar than miniplate group. For tooth germ measurements, RME group showed greater advancement of both maxillary second premolar and second molar tooth germs than miniplate group.
Conclusion : The RME group showed more advancement of not only erupted maxillary incisor and first molar, but also tooth germs of second premolar and second molar than the miniplate group.

P-115

Comparison of Craniomaxillofacial Changes when Using High-pull J-hook Headgear and Mini-implant Anchorage in Adolescents

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Objectives : The aim of this study was to compare the craniomaxillofacial changes when using high-pull J-hook headgear (HPJH) and mini-implants (MIs) as maxillary anchorage in adolescents.
Material and Methods : 44 female adolescents with Class I or Class II division 1 malocclusion with dentoalveolar protrusion were treated with four premolar extractions. The subjects were divided into 2 groups according to the type of maxillary anchorage; the HPJH group (n=22) and the MI group (n=22). Lateral cephalograms were taken before treatment (T0) and after anterior tooth retraction (T1). They were superimposed on the stable structures of the anterior cranial base, maxilla, and mandible, respectively and then craniomaxillofacial changes were evaluated.
Results : The cranial base angle, SNB, and HRL/N-Pog decreased in the HPJH group but increased in the MI group ($P < 0.05$). ANB decreased more in the MI group than in the HPJH group ($P < 0.001$). FMA increased in
the HPJH group but decreased in the MI group ($P < 0.01$). Maxillary true rotation occurred counterclockwise in both groups with no significant difference. Mandibular true rotation occurred clockwise in the HPJH group and counterclockwise in the MI group ($P < 0.01$). Maxillary central incisors intruded more in the MI group than in the HPJH group ($P < 0.01$). Maxillary first molars extruded in the HPJH group and intruded in the MI group ($P < 0.001$). Maxillary first molars moved mesially more in the HPJH group than in the MI group ($P < 0.01$). Mandibular central incisors and first molars extruded more in the MI group than in the HPJH group ($P < 0.05$). There were no significant craniomaxillofacial changes relative to age, maturation stage or skeletal patterns.
Conclusion : More favorable craniomaxillofacial changes occurred in the MI group than in the HPJH group. Thus, there is an evidence-based rationale for using MI than HPJH clinically in adolescents.

P-116

Outcome Evaluation of Camouflage Treatment of Mandibular Asymmetry Using Customized Brackets Based on Manual Setups

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Objectives : The purpose of this study was to evaluate the treatment outcome and the clinical accuracy of conventional orthodontic setups in camouflage treatment of mandible asymmetric patients by registration of the setup and final models.
Material and Methods : Initial models, manual setups, and final models of 10 asymmetric patients were scanned to create digital models, segmentation of each tooth and Peer Assessment Rating (PAR) Index scoring were carried out in 3Shape OrthoAnalyzer software. Treatment outcomes were evaluated by comparing posteroanterior radiographic tracing and PAR index pre- and post-treatment. Superimposition of setup and final models within jaws based on whole arch best-fit alignment and every single tooth best-fit alignment were done in 3D engineering software, then individual tooth discrepancies were expressed in terms of translations in 3 directions and rotation (torque, angulation, and long-axis rotation) by calculating the individual coordinate system deviation of single tooth.
Results : Weighted PAR index decreased from 30.27 ± 10.09 to 2.45 ± 2.71 after camouflage treatment. Between the manual setup and final models, all mean discrepancies for translational variables are smaller than 1mm while lower 2nd molar had largest labiolingual deviation (0.97 ± 0.97 mm). The mean mesiodistal discrepancies of whole upper and lower arch were 0.02 ± 0.29 mm and 0.15 ± 0.29 mm, which indicated an excellent control on mesiodistal movement. Among rotational parameters, the results of long-axis rotation showed the final model did not complete distal rotation perfectly as expected in lower posterior arch and upper molars presented larger crown labial torque than expected.
Conclusion : Malocclusions got great improvement in asymmetric patients underwent camouflage treatment with customized brackets based on manual setups, and minor discrepancies were found between the setups and final models except rotational control of 2nd molars, thus the manual setups had an overall clinical acceptable prediction of final outcomes.

P-117

Comparative analysis of irregularity quantity and pattern from 5 years post-retention relapse on lower incisors.

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Objectives : The purposes of this study are to evaluate the relapsed irregularity quantity between patients of well-wearing and not-wearing a wrap-around retainer and to investigate the relapse pattern of contact points with irregularity index analysis during 5 -year post-retention .
Material and Methods : The study samples comprised 128 patients with 50 not-wearing patients(G1) and 78 well-wearing patients(G2). Patients were treated with fixed appliances and worn the same type of wrap-around retainer for retention. Study casts were available at pre-treatment(T1), post-treatment(T2) and longer than 5-year post-retention(T3). Well or not-wearing patients were selected according to each patient chart's record and the retention policy observance followed until 5-year post-retention. After scanning cast models at T1, T2, T3 by using a 3D laser scanner, Little's irregularity index(LII) and Intercanine width(IW) was measured on the 3Shape OrthoAnalyzer™ software(3Shape, Copenhagen, Denmark).
Results : G1 showed more increase of LII than G2 from T2 to T3, but the higher a LII was at T1, the larger a difference between G1 and G2 became. The total ILL of both G1 and G2 had the increase of 0.52 ㎜ for T3-T2 in slight group but 1.55 in moderate and 1.78 in severe crowding. For G2 the irregularity showed a little difference, mean 0.85 ㎜(0.39 -1.29) of T3-T2 in spite of different crowding severity before treatment. From two-way repeated measures ANOVA the mean value of T2-T3 difference were significant in C1 and C2 of G1 at $P<0.001$, in C3 and C5 of G1 at $P<0.05$. C1 and C2 showed about 0.6 ㎜ relapse whereas others 0.35-0.44 ㎜.
Conclusion : Considering the relapse pattern of contact points from our results, the right lateral incisor tended to displace more from adjacent teeth than others. If patients want to quit wearing retainer, the simple way to recommend is to fix only the lateral incisors with canines.

P-118

Post Treatment Stability of Anterior Open-bite Between Orthognathic 2-jaw Surgery and Molar Intrusion

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Objectives : The purpose of this study is to compare long-term stability of anterior open bite (AOB) treatment between orthognathic 2-jaw surgery and molar intrusion using orthodontic miniscrews with the same sample size and similar patients' characteristics.
Material and Methods : This retrospective study included surgical and non-surgical groups (N = 21 each). The non-surgical group was selected based on the following inclusion criteria: overbite (OB) <1 mm, menton deviation < 4 mm, completion of growth, without systemic disease, and availability of records before treatment (T0), immediately after AOB correction (T1), after treatment (T2), and at least 1-year after treatment (T3). The surgical group was selected by one-by-one matching with overbite, sex, and age to the non-surgical group. Changes in cephalometric measurements during treatment (T1-T0), finishing (T2-T1), and retention (T3-T2) periods were compared between two groups.
Results : During treatment period, the maxillary first molar (U6) moved upward 3.3 mm in both groups, and OB increased by 4.5 mm in non-surgical group and 5.1 mm in surgical group. During finishing period, changes in OB were not significantly different, although U6 moved 0.5 mm downward in non-surgical group but 0.1 mm upward in surgical group (P=0.000). During retention period, U6 moved 1.0 mm and 0.4 mm downward in non-surgical and surgical groups, respectively. However, OB similarly decreased by approximately 1.0 mm in both groups.
Conclusion : The post-treatment stability of AOB was 80%, which was similar between surgical and non-surgical methods. Although U6 showed more downward in non-surgical group than in surgical group, OB was not significantly different between two groups.

P-119

Evaluation of Root Resorption after Maxillary Total Distalization in Class II Patients with Sinus Pneumatization

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Objectives : The purpose of this study was to evaluate root resorption of posterior teeth after maxillary total arch distalization using Modified C-palatal plate (MCPP) according to maxillary sinus pneumatization.
Material and Methods : This study consisted of Cone Beam Computer Tomography (CBCT) images of 40 cases (24 female 16 male), which were treated Class II adult patients. CBCT images were obtained and the root length change was calculated. The samples were divided into two groups according to maxillary sinus pneumatization. Group 1 (pneumatization group : n=20; females 13 males 7) and Group 2 (non pneumatization group: n=20; females 17 males 3) who underwent bilateral total arch distalization of maxillary dentition using MCPP. Paired t tests used for comparison of changes in each group, and an independent t tests were used for comparison of changes between two groups.
Results : In group 1, most affected tooth was palatal root of first molar (2.09mm) and the minimum root resorption was second premolar (0.03mm). In Group 2, most affected tooth was mesiobuccal root of first molar (1.63mm) and minimum was first premolar (0.35mm). For the second molars distobuccal root showed largest root resorption (1.73mm) in group 1, palatal root showed largest root resorption (1.25mm) in group 2. There was significant difference of root resorption on mesiobuccal root and distobuccal root of second molar according to pnuematization.
Conclusion : There were significant difference in the mesiobuccal root and distobuccal root of second molar root resorption according to maxillary sinus pneumatization when distalizied using MCPP.

P-120

Comparison of the Changes in the Width of Mandibular Arches between Non-extraction and Extraction

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Objectives : The changes of the mandibular width of the mandibular arch before and after the treatment of non-extraction orthodontic treatment and the second premolar extraction orthodontic treatment in Class III malocclusion patients. The purpose of this study was to investigate the difference between the changes of the mandibular arch width before and after orthodontic treatment in Class I malocclusion patients.
Material and Methods : I studied 80 patients who underwent orthodontic treatment at the Department of Orthodontics, Anam Hospital, Korea University. Using the dental cast model before and after treatment, the widths of mandibular canines and mandibular molars were measured, and the changes of the groups were compared.
Results : The width of mandibular canine was increased both in Class III and Class I malocclusion. The width of the mandibular molar was increased during treatment of Class I non-extraction treatment and decreased during treatment of Class III and Class I second premolar extraction treatment. Comparing changes in the mandibular canine width, the width of the Class III second premolar extraction treatment was higher than that of the nonextraction treatment. Comparing the changes in the mandibular molar width, the decrease in the width of the second premolar extraction treatment was more prominent than in the non-extraction treatment.
Conclusion : The second premolar extraction treatment can be used as a treatment method for class III malocclusion patients. It is necessary to predict the change of the arch width and stabilize it after treatment.

P-121

CBCT-based Evaluation of Alveolar Bone Remodelling in Microimplant-supported Anterior Retraction Treatment

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Objectives : The purpose of this study is to evaluate alveolar bone remodelling following incisal retraction with microimplant and to examine relationship between crown/root distal movement and thickness/height changes of alveolus.
Material and Methods : 24 patients (mean age, 19.29 ± 4.64 years) with bialveolar protrusion, treated by incisal retraction with microimplant, were included. By analyzing CBCT before (T1) and after treatment (T2), the distance of incisal edge and root tip movement (incisal edge, Mov-E; root tip, Mov-R) and the thickness (labial, ABT-La; lingual, ABT-Li; Total, ABT-To) and vertical level (labial, VBL-La; lingual, VBL-Li) of alveolar bone were measured. The all variables of T1 and T2 were compared, and further comparisons of alveolar bone changes were conducted between two groups based on Mov-E (Elow and Ehigh groups) or Mov-R (Rlow and Rhigh groups). To determine correlation of Mov-E or Mov-R with the variables of alveolar bone changes, Pearson correlation coefficient was calculated.
Results : Significant differences were found in VBL-La, VBL-Li, ABT-La, and ABT-Li after incisal retraction treatment in the both jaws, except for ABT-To. According to Mov-E or Mov-R, the variables regarding alveolar bone change significantly differed between Rlow and Rhigh groups, while there was no significant difference between Elow and Ehigh groups. Additionally, Mov-R showed significant correlation with the variables.
Conclusion : Remarkable changes in height and thickness of alveolar bone were found after treatment of microimplant-aided incisal retraction excepting ABT-To. Mov-R was significantly correlated with the alveolar bone changes, while Mov-E showed no significant correlation.

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Orthognathic Surgery with Alveolar Bone Graft in Bilateral Cleft Lip and Palate Patient

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Introduction : Maxillary deficiency is the most common skeletal problem in patients with cleft lip and cleft palate. There are many limitations in maxillary advancement. Soft tissue limiting factors include palatal, pharyngeal, lip scar tissue, and pharyngeal flaps due to previous surgery. Skeletal limiting factors include fistula or bony gap, remaining in the maxilla, and anterior-posterior skeletal discrepancy. In particular, the fistula remaining in the maxilla makes orthognathic surgery difficult. The purpose of report is to introduce a case of orthognathic surgery in bilateral cleft lip and palate patient with fistula remaining.
Case Summary : A 19-year-old woman with a bilateral cleft lip and palate was diagnosed with a skeletal Class III malocclusion with maxillary deficiency and remaining oronasal fistula. The cleft area was located on both sides of the missing lateral incisors, and the fistula was located in the anterior part of the palate. Presurgical orthodontic treatment was made to secure the graft site. The anterior space between the canines was regained using open coil spring and overlaying NiTi wire. After regaining the space, bone graft was performed with cancellous bone obtained from the left iliac crest.
After 6 months of osteogenic period, orthognathic surgery was performed with Le Fort I osteotomy with 3mm advancement, B-SSRO with 8mm setback. Through 7 month of postsurgical orthodontic treatment, skeletal Class I relationship and proper overjet and overbite were well-accomplished.
Conclusion : During presurgical orthodontic treatment, sufficient space was regained for the iliac bone graft at the rupture site. After the bone graft, follow-up checks about sufficient bone quality were made over period of 6 months. And then, orthognathic surgery was performed, which resulted in good surgical results. Clinically, the formation of intact maxilla with no fistula before orthognathic surgery is important for the stability of maxillary advancement.

P-123

Three-dimensional Virtual Treatment Planning for Orthognathic Surgery in Yaw-dominant Facial Asymmetry Patient

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Introduction : Skeletal discrepancies and the patterns of dental compensation must be analyzed with cone-beam computed tomography (CBCT). Horizontal decompensation of pre-surgical orthodontic treatment for orthognathic surgery is complicated in yaw-dominant facial asymmetry patient. Then, using surgical simulating program, surgical treatment objectives (STO) can be visualized on 3-dimension (3D).
Case Summary : An 18-year-old man with chief complaints of facial asymmetry and protruded chin was diagnosed with a skeletal Class III malocclusion with yaw-dominant facial asymmetry, maxillary canting and a dental Class III with unilateral crossbite on right and maxillary arch constriction on left side. For transverse decompensation, micro-implant assisted rapid palatal expansion was planned and differential expansion was applied. Then, the screws on the palate were used for uprighting of upper posterior teeth. The right posterior teeth on mandible were distalized and bucally uprighted so that the lower dentition was uprighted to basal bone along with the midline coincident to the apical base midline. Posterior impaction of maxilla with canting correction by Le Fort I and asymmetric set-back of madible for yawing correction by B-SSRO were simulated by 3D virtual surgery program (ON3D, 3DONS, Inc). After the surgery and 5-month of post-surgical orthodontic treatment, skeletal and dental Class I relationship and proper overjet and overbite were well-accomplished. The facial asymmetry had improved a lot that the patient was satisfied of the treatment.
Conclusion : By using CBCT, type of facial asymmetry must be diagnosed and possible range of teeth movement should be evaluated prior to establish the pre-surgical orthodontic treatment objectives. For yaw-dominant facial asymmetry patient, targeted pre-surgical orthodontic treatment should be focused on horizontal decompensation; symmetric dental arched, dental midline on apical base midline, asymmetric distalization. Clinically, the predictability of the surgery can be increased by the 3D virtual STO.

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Surgical-orthodontic Treatment of Skeletal Class Ⅲ Malocclusion with Vertical Discrepancies between Anterior and Posterior Teeth

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Introduction : When the degree of skeletal discrepancy in skeletal Class III open bite patient is severe, orthognathic surgery is considered first to obtain optimal esthetic appearance and functional occlusion. Preoperative orthodontic treatment includes a decompensation of the compensated the maxillary and mandibular incisors to a normal angle and adjusting the width of both arches to achieve good occlusion after surgery. Patients who have severe vertical discrepancy between the anterior and posterior teeth with 2 different occlusal plane need special attention to correct the vertical discrepancies during preoperative orthodontic treatment. In this case, selective intrusion of premolars may be required for stable occlusion after surgery.
Case Summary : A 37-year-old female patient had chief complaint of open bite and mandibular prognathism. Clinical observation showed anterior open bite with vertical discrepancies between anterior and posterior teeth, mild crowding in both arches, and a Class III molar relationships. In lateral cephalometric analysis, she had a skeletal Class III with hyperdivergent pattern and protrusive lips relative to the E-line. Based on this problem list, skeletal Class III malocclusion with 2 plane openbite was diagnosed, and 2-jaw surgery was planned to correct the skeletal discrepancies.
During preoperative orthodontic treatment, intrusion of premolars was performed to level the occlusal plane. For lateral decompensation, miniscrew assisted rapid palatal expansion was used to constrict the right side of the maxilla and expand the left side. Canting of the maxillary incisors was corrected dentally.
2-jaw surgery was performed with maxillary posterior impaction and setback and mandibular setback and asymmetry correction. For postoperative orthodontic treatment, maxillary anterior canting was improved and tight interdigitation was achieved.
Conclusion : In skeletal Class III openbite patients with severe vertical discrepancies between anterior and posterior teeth, well-planned 3-dimensional dental decompensation would ensure stable occlusal result. Selective intrusion of premolars may be one of the treatment options.

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Orthognathic surgery in the patients with previous history of orthodontic camouflage treatment

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Introduction : A combined orthodontic and orthognathic surgery approach is accepted as the standard of care for patients who have a skeletal discrepancy. Orthodontic preparation including alignment, interarch coordination, and dental decompensation, is necessary to increase surgical jaw movement and to maximize stable post-operative occlusion. While the orthodontic preparation is performed traditionally before the surgery, some disadvantages, such as worsening of facial appearance and exacerbation of malocclusion, have been recognized. In particular, decompensation treatment will be frustrating to the patients who received previous orthodontic treatment in the manner of camouflage. To overcome this disadvantage, a surgery-first approach can be suggested.
Discussion : With a skeletal discrepancy, all the teeth show a tendency of compensation. In case of skeletal Class III with asymmetry, upper incisors are proclined and lower incisors are retroclined. Upper posteriors on one side will show buccoversion while lower posteriors on the same side will present linguoversion. If we do a camouflage treatment for that patient, proper inclination is not achieved. Rather the teeth are moved in the same direction with dental compensation. If the patients want a correction of their face, orthognathic surgery is provided to eliminate jaw discrepancies. If we do dental decompensation treatment as an orthodontic preparation for the surgery, it will be frustrating to the patient. All the orthodontic tooth movement including dental decompensation needs to be postponed to after the surgery. Present presentation will present clinical protocol of surgery-first orthognathic treatment with typical clinical case examples.
Conclusion : A successful surgical orthodontic treatment is possible with the help of surgery-first approach in the patients with previous history of orthodontic camouflage treatment.

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A proper interaction between surgeon and orthodontist for a successful surgery first orthognathic treatment

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Introduction : Recently, the interest in surgery-first orthognathic treatment is increasing among the practitioners since patients appreciate immediate improvement in facial appearance. Orthodontic tooth movement is much easier and more physiologically favorable after surgical elimination of the skeletal disharmony. For a successful SF orthognathic treatment, a proper collaboration between surgeons and orthodontists is believed to be essential. It is because surgical occlusion is constructed based on orthodontic simulation.
Discussion : Through the examination and analyses, a diagnosis is made and a surgico-orthodontic treatment objective (SoTO) is established. Not a mere STO but the SoTO is made through the collaboration of surgeons and orthodontists. After construction of surgical occlusion, final splint and intermediate splints are fabricated according to the SoTO. After the surgery, the splint is not discarded but is kept in the mouth to maintain orthognathic position of mandible. Present presentation will present rationale of SF orthognathic treatment and suggest a clinical protocol for the success of ortho-surgical treatment. In particular, the importance of interaction between surgeons and orthodontists will be emphasized by addressing following issues: (1) Who decides surgery first or not (2) Who decides surgery type (3) Who determines surgical occlusion (4) Who determines jaw position (5) Who is responsible for post-surgical management.
Conclusion : A successful surgery-first treatment is possible with the help of proper interaction between surgeons and orthodontists. More and more patients could benefit from surgery-first orthognathic treatment.

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A Proposal to Set the Absolute Midsagittal Plane of the Mandible Using a Similarity Index

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Introduction : This study sought to test the feasibility of a newly developed plane called computed modified absolute mandibular midsagittal plane (cmAMP) based on the similarity index (SI) for evaluating the stereoscopical symmetry of the mandible by comparison with other proposed midsagittal planes. This study involved 29 adult patients (15 men, 14 women; average age, 23.1 ± 6.9 years) with skeletal Class III facial asymmetry who underwent bimaxillary orthognathic surgery. Using cone-beam computed tomography images taken before and 1 year after surgery, cmAMP with the highest SI value between the two anterior segments of the hemi-mandible was set by a computer algorithm.
Discussion : Results show that the SI using cmAMP had the highest value (0.83 ± 0.04) before surgery compared to the other midsagittal planes, and was not significantly different from the SI (0.80 ± 0.05) using a facial midsagittal plane (MSP) after surgery. The distance (1.15 ± 0.74 mm) and angle (2.02 ± 0.82°) between MSP and cmAMP after surgery were significantly smaller than those between MSP and other midsagittal planes.
Conclusion : A novel method to set up the midsagittal plane of the mandible anterior segments called cmAMP was developed by using the SI to evaluate the stereoscopic symmetry of the mandible. cmAMP plane best matches the two anterior segments of hemi-mandible symmetrically and is the closest to MSP after orthognathic surgery in skeletal Class III patients with facial asymmetry. With cmAMP, it will maximize the symmetry of the mandible after surgery and reduce the need for additional surgery such as bone graft, mandible contouring, and chin osteotomy(genioplasty). It will also be useful to create surgical guides during actual surgical planning and simulation by grafting cmAMP into 3D software.

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Three-dimensional Facial Soft Tissue Changes after Bimaxillary Orthognathic Surgery in Cleft Patients

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Introduction : The purpose of this study was to investigate three-dimensional changes in facial soft tissue including nose, upper and lower lips, and chin after bimaxillary orthognathic surgery (BOGS) in patients with cleft lip and palate. The samples consisted of 34 Korean young adult patients with skeletal class III malocclusion who underwent BOGS for maxillary advancement/posterior impaction and mandibular setback. They were divided into cleft-class III (C-CIII) group (n=18) and noncleft-class III (NC-CIII) group (n=16). Three-dimensional computed tomography images were taken 1 month before (T1) and 3 months after (T2) surgery. After 34 hard/soft tissue landmarks were automatically identified using software, the amount and direction of change in landmarks and the amount of change in 16 soft tissue variables during T1-T2 were calculated. Then, statistical analysis was performed.
Discussion : Compared to NC-CIII group, C-CIII group showed more posteriorly-positioned hard/soft tissue landmarks, larger alar width, alar base width and philtrum width, and more obtuse nasal tip angle at both T1 and T2 stages. C-CIII group exhibited higher soft-to-hard tissue movement ratios at the bottom of the nose (ΔSn/ΔANS, 1.08 versus 0.81) and the upper part of the upper lip (ΔPoint A'/ΔPoint A, 1.08 versus 0.91), but a lower ratio at the lower part of the upper lip (ΔLs'/ΔIs, 0.72 versus 1.01) than NC-CIII group. The number of hard-soft tissue landmarks with high correlation (>0.90) was smaller in C-CIII group than in NC-CIII group (2 versus 6).
Conclusion : Scar tissues and abnormal muscles in the nose and upper lip might elicit different responses in the nasolabial soft tissues to BOGS, leading to suboptimal esthetic outcomes in the nasolabial complex in cleft patients. Therefore, it is recommended to perform adjunctive aesthetic surgeries, including corrective rhinoplasty, cheiloplasty, and allograft after BOGS in cleft patients.

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The influence of pre-operative surgical occlusion on post-operative stability in skeletal class III malocclusion patients

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Objectives : This study aims to evaluate the influence of completeness of pre-operative surgical occlusion on post-operative stability (skeletal change) in skeletal class III malocclusion patients who had 1 jaw BSSRO setback surgery.
Material and Methods : The completeness of the pre-operative surgical occlusion was assessed by the occlusal contact area of the surgical occlusion. The dental casts of patients just before surgery were scanned by 3D scanner, converted to STL files, and the occlusal contact area was measured.
Post-operative stability was assessed by comparing the right lateral half cephalogram generated using CBCT taken at two to four weeks after surgery (T1) with the cephalogram generated using CBCT taken at debonding (T2). Specifically, to determine the total relapse amount between T1 and T2 period, the vertical and horizontal distances of the pogonion point of T1 (pog T1) and pogonion point of T2 (pog T2) were measured. The amount of total relapse constituted of rotational and true surgical relapse. To measure each variable, mandible at T1 was superimposed on to the mandible at T2 by rotating around the articulare (Ar), and the transferred position of pog T1 onto the Ar-pog T2 line was named pog T1'. The amount of true surgical relapse and the rotational relapse were calculated by measuring the distances between pog T1' and pog T2, and between pog T1 and pog T1' respectively.
Results : The total, rotational, and true surgical relapse tended to be small in patients with large occlusal contact area of surgery occlusion.
Conclusion : Large occlusal contact area of surgery occlusion can contribute to reducing the amount of post-operative relapse (skeletal change).

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Intra- and Inter-observer Reliability of Integration of Maxillary Digital Models on Cone Beam Computed Tomography

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Objectives : The aim of this study was to evaluate the intra- and inter-observer reliability of integration of maxillary digital dental models into cone-beam computed tomography (CBCT) scans to reconstruct three dimensional (3D) skeletodental model in orthognathic patients.
Material and Methods : This retrospective study consisted of CBCT and digital maxillary dentition images of 20 Class III patients (mean age 21.7 ± 4.0 years), who had undergone orthognathic surgery. After their digital dentition images were immerged with reconstructed CBCT images, the 3D coordinate values (x, y, and z) of the canines, first molars, and maxillary central incisors in the coordinate system were measured. The differences of the 3D coordinate values between two repeated fusions by a digital engineer and an orthodontist were evaluated respectively. The intra- and inter-observer reliability of 3D position of maxillary teeth using intraclass correlation coefficients (ICCs).
Results : Intra-observer reliability of x-, y-, and z coordinate values of maxillary teeth showed significant excellent agreement in an engineer ($0.946 \leq ICC \leq 1.000$, $P < 0.001$) and an orthodontist ($0.876 \leq ICC \leq 1.000$, $P < 0.001$), respectively. Inter-observer reliability of Y- and Z-coordinates of each tooth was significant excellent or good, but that of X coordinates showed insignificantly poor to moderate agreement. The teeth position after repeated registration showed the mean deviations ranging from -0.04 to 0.03 mm by an engineer and from -0.56 to 0.14 mm by an orthodontist, but there was no significant intergroup difference.
Conclusion : This study showed that the integration of maxillary digital models into CBCT scans was clinically reliable. However, considering low to moderate inter-observer reliability on X coordinates of dentition, it may take repeated experience and learning curve to reduce 3D positioning errors.

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Changes in Condylar Volume and Morphology after Orthognathic Surgery Using a Customized versus Conventional Miniplate

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Objectives : With the great leap in the development of three-dimensional computer-assisted surgical technology, surgeons can use a variety of assistive methods to achieve better results and evaluate surgical outcomes in detail. This retrospective study aimed to evaluate the postoperative stability after bilateral sagittal split ramus osteotomy by volume rendering methods and to evaluate how postoperative stability differs depending on the type of surgical plate.
Material and Methods : Of the patients who underwent BSSRO, ten patients in each group (non-customized miniplate and customized miniplate) who met the inclusion criteria were selected. In the NCP group, surgical planning was operated with a CASS system (InVivoDental v5.0 (Anatomage, San Jose, CA, USA)); however, titanium plates were bent and applied directly in the operation room to secure the moved bone fragments. In the CP group, plates were premade according to the preoperative 3D diagnosis and design. Preoperative and postoperative cone-beam computed tomography data were collected, and condylar morphological and landmark measurements were obtained using Checkpoint and OnDemand software, respectively.
Results : The postoperative condylar morphological dataset revealed no significant difference ($p > 0.05$) between the two groups. No significant difference ($p > 0.05$) was observed between the two groups in horizontal, vertical, or angular landmark measurements used to quantify operational stability.
Conclusion : These results indicate that there is no difference in the surgical outcome between the patient-specific system and the conventional method, which will allow clinicians to take advantage of the patient-specific system for this surgical procedure, with favorable results, as with the conventional method.

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Comparison of Alveolar Bone Alteration between Conventional and Surgery-first Orthognathic Treatment

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Objectives : The purpose of this study was to investigate the alveolar bone changes around mandibular incisors in patients with skeletal Class III malocclusion treated with surgery-first orthognathic approach (SFA) and conventional orthognathic surgery (COS) using images generated with cone-beam computed tomography (CBCT) generated images.
Material and Methods : The subjects consisted of 30 patients who were treated with SFA and 30 patients who treated with COS. CBCT was obtained before treatment (T0), and presurgical orthodontic treatment (T1), and after treatment (T2). The sagittal slice were used to measure the thickness of alveolar bone and vertical marginal bone level and alveolar bone area on both labial and lingual aspects and the root length at T0, T1 and T2 time points.
Results : The levels and thickness of the labial and lingual vertical bones and the area of the alveolar bone around the mandibular incisors were reduced after treatment in both SFA and COS groups. Vertical alveolar bone loss was prominent than horizontal bone loss after treatment in both groups. Alveolar bone loss was greater on lingual side than on the labial side. Alveolar bone changes around mandibular incisors between SFA and COS groups showed no statistically significant differences. However, in the COS group, the alveolar bone was reduced greater than in the SFA group.
Conclusion : The results indicate that both SFA without presurgical orthodontic treatment and COS with presurgical orthodontic treatment may trigger loss of the alveolar bone around mandibular incisors in patients with mandibular prognathism. Careful consideration should be taken to avoid iatrogenic bone loss of periodontal support around the incisors, particularly during presurgical orthodontic treatment.

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Clinical Consideration of Facial Symmetry According to Changes in the Frankfort Horizontal Plane

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Objectives : The plane formed by the intersection of bilateral porions (PoR and PoL) and left orbitale (OrL) is conventionally defined as the Frankfort horizontal (FH) plane. We aim to test the influence of the FH plane definition on a 3D cephalometric assessment.
Material and Methods : We selected 38 adult patients (20 males, 18 females; average age: 22.87 ± 5.17 years) without any gross asymmetry from retrospective records and traced and analyzed their cone-beam computed tomographic images. The findings were categorized into the following four groups: FH1: conventional; FH2: PoR, PoL, right orbitale (OrR); FH3: OrR, OrL, PoL; FH4: OrR, OrL, PoR.
Results : The average menton (Me) deviation from the MSP was statistically significant for the FH1 group (0.56 ± 0.27 mm; $p < 0.001$), compared to the FH3 (1.37 ± 1.23 mm) and FH4 (1.33 ± 1.16 mm) groups. The spatial orientation level (SOL) of the FH plane showed a marked difference ($p < 0.05$) between the FH2 (0.602° ± 0.503°) and FH4 (0.944° ± 0.778°) groups. The SOL of the MSP was comparatively small ($p < 0.001$) for FH2 (0.015° ± 0.023°) in comparison to both FH 3 (0.644° ± 0.546°) and FH 4 (0.627° ± 0.516°).
Conclusion : The FH plane definition can significantly influence the interpretation of cephalometric findings. Future studies should focus on standardization to improve the reliability and reproducibility of 3D cephalometry.

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Tomographic Similarity Scan with cmAMP for Precise and Objective Localization of Mandibular Asymmetry

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Objectives : The application of three-dimensional (3D) imaging is at its cusp in craniofacial diagnosis and treatment planning. However, most applications are limited to simple subjective superimposition-based analysis. As the diagnostic accuracy dictates the precision in operability, we propose a novel method that enables objective clinical decision-making for patients with mandibular asymmetry.
Material and Methods : We analyzed cone-beam computed tomography (CBCT) scans of 34 patients who underwent surgical correction for mandibular asymmetry using a high-throughput computing algorithm. Radiomic segmentation of quantitative features of surface and volume followed by exploration resulted in identification of a computed modified absolute mandibular midsagittal plane (cmAMP). Tomographic similarity scan (ToSS) curves were generated via bilateral equidistant scanning in an antero-posterior direction with cmAMP as the reference. ToSS comprised of a comprehensive similarity index (SI) score curve and a segmentwise volume curve. The SI score was computed using the Sørensen–Dice similarity coefficient ranging from 0 to 1. The volumetric analysis was represented as the non-overlapping volume (NOV) and overlapping volume (OV) for each segment, with two segmentation lines, at the mental foramen anteriorly and the intraoral vertical ramus osteotomy region posteriorly.
Results : Statistical analysis showed strong negative correlation between the NOV and SI scores for the anterior, middle, and total mandible ($P < 0.001$). Additionally, a significant correlation was observed between the change in the SI scores for anterior ($P = 0.044$) and middle segments ($P < 0.001$) to the total mandible when comparing the data before and after the surgery.
Conclusion : This work demonstrated the potential of incorporating ToSS curves in surgical simulation software to improve precision in the clinical decision-making process.

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Soft Tissue Changes According to the Increased Occlusal Vertical Dimension

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Introduction : Vertical control is one of the most challenging assignments for orthodontists. In the soft tissue paradigm, soft tissue changes with covalent occlusal vertical dimension(OVD) are also an important issue in orthodontic treatment. Therefore, the purpose of this E-poster was to review the studies on soft tissue changes according to the increased occlusal vertical dimension.
Discussion : The vertical dimension when the mandibular teeth are occluding with the maxillary teeth is defined as the occlusal vertical dimension. In the frontal smile position, the increase in the OVD resulted in an increase in the interlabial gap height, incisal edge to lower lip distance and display zone area. In the frontal resting position, as a result of the gradual increase in the OVD, the ratio of the lower facial height, lip height and nasolabial angle were increased. Whereas, the smile index and lip width decreased with the increase of the OVD. In subjects with normal vertical skeletal pattern, the subjective facial aesthetic changes resulting from increased OVD vary from paper to paper. Some articles reported that although there was an increase in the OVD from 2mm to 6 mm, soft tissue changes were not well recognized. However, other articles have shown that the OVD has greatly influenced the overall facial aesthetic assessment. Even a 3mm increase in OVD in normal subjects was well recognized and assessed as less aesthetic.
Conclusion : Orthodontists should be aware of the most likely soft tissue changes associated with the OVD change. The objective characteristics of the changes in multiple linear soft tissue measurements according to the OVD need to be understood. However, in terms of subjective soft tissue aesthetic assessment, it is controversial that the increase in OVD has a significant effect on the patient's facial aesthetics.

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Assessment of Pharyngeal Airway in Korean Adolescents according to Cervical Vertebral Maturation

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Objectives : To investigate airway volumes using cone-beam computed tomography (CBCT) by the skeletal patterns, sex, and cervical vertebral maturation (CVM) stages in Korean adolescents.
Material and Methods : The sample consisted of pretreatment CBCT and cephalograms of 95 adolescents (aged 12-19) obtainedout of 8,361 patients examined for orthodontic treatment from 2018 to 2020 in Kyungpook National University Dental Hospital. The samples were classified into two gender groups; three skeletal pattern groups, four chronological age groups and four CVM stages. For airway assessment, nasopharyngeal (NPV), oropharyngeal (OPV), total airway (TAV) volumes and minimum cross-sectional area (MCA) measurements were taken from the CBCT. Comparisons between sexes were analyzed using a T-test, and comparisons among skeletal groups and growth stages were analyzed using analysis of variance tests.
Results : OPV, TAV, and MCA values of the Class II group (8834. 38, 12678.13, and 150.22) were significantly smaller than those of the Class II group (11545.16, 16083.87 and 232.98) (p-value: 0.040, 0.035, and 0.002, respectively). Males and females showed similar patterns of change in chronological age groups 1-3; however, males had lager NPV, OPV, TAV in group 4 (p-value: 0.003; 0.023; 0.008; 0.039, respectively). Accroding to CVM stages, males had larger OPV, TAV, and MCA at CVM stage 6 (p-value: 0.019; 0.021; 0.015, respectively) and no sex differences at CVM stages 3,4, and 5.
Conclusion : Skeletal patterns have an effect on airway volume. Gender differences were found in CVM 6. The CVM stage can provide useful information for pharyngeal airway volume assessment.

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Scanning Accuracy of Bracket Features and Slot Base Angle in Different Bracket Materials

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Objectives : The accurate expression of bracket prescription is important for successful orthodontic treatment. The aim of this study was to evaluate the accuracy of digital scan images of brackets produced by four intraoral scanners (IOSs) when scanning the surface of the dental model attached with different bracket materials.
Material and Methods : Brackets made from stainless steel, polycrystalline alumina, composite, and composite/stainless steel slot were considered, which have been scanned from four different IOSs (Primescan, Trios, CS3600, and i500). SEM images were used as references. Each bracket axis was set in the reference scan image, and the axis was set identically by superimposing with the IOS image, and then only the brackets were divided and analyzed. One-way analysis of variance (ANOVA) was used to compare the differences.
Results : The difference between the manufac-turer's nominal torque and bracket slot base angle was 0.39 in SEM, 1.96 in Primescan, 2.04 in Trios, and 5.21 in CS3600 ($P < 0.001$). The parallelism, which is the difference between the upper and lower angles of the slot wall, was 0.48 in SEM, 7.00 in Primescan, 5.52 in Trios, 6.34 in CS3600, and 23.74 in i500 ($P < 0.001$).
Conclusion : This study evaluated the accuracy of the bracket only, and it must be admitted that there is some error in recognizing slots through scanning in general.

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Accuracy and Efficiency of Automatic Tooth Segmentation in Digital Dental Model Using Deep Learning

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Objectives : This study aimed to evaluate the accuracy and efficiency of automatic tooth segmentation in digital dental model using deep learning.
Material and Methods : In this study, an algorithm based on dynamic graph convolutional neural networks (DGCNN) was developed for tooth segmentation and classification, and 516 pairs of digital dental models were used for deep learning. Tooth segmentation was performed by Landmark based tooth segmentation method (LS), Tooth designation and segmentation method (DS), and Automatic tooth segmentation method (AS). 30 pairs of replicated digital models were used for each of the three experimental and control groups (REF). We evaluated the segmentation success rate, mesiodistal width (MD) and clinical crown height (CCH), and segmentation time using a total of 3360 teeth including the second molar. As a statistical method, Cochran's Q test and Freidman's test were used.
Results : The success rates of tooth segmentation were 97.26% and 97.14% in AS and LS, respectively, showing a significantly higher success rates than 87.86% in DS ($p<0.001$). The mean (95% confidence interval) of MD were 8.28(8.15, 8.41) mm in LS and 8.63(8.49, 8.76), 8.51(8.37, 8.65) mm in DS and AS, respectively. There was significant difference in MD among three groups ($p<.001$). The mean of CCH was 7.65 (7.52, 7.78) mm in LS and 7.52 (7.39, 7.65), 7.58(7.45, 7.70) mm in DS and AS, respectively. CCH was significantly higher in LS compared to DS and AS ($p<.001$). The mean of segmentation times were 57.73 (54.43, 61.04) seconds in AS and 150.73 (140.70, 160.77), 424.17 (404.28, 444.05) seconds in DS and LS, respectively. There was significant difference in segmentation time among three groups ($p<0.001$).
Conclusion : Automatic tooth segmentation of a digital dental model using deep learning shows a high segmentation success rate, accuracy, and efficiency, so it can be used for orthodontic diagnosis and appliance fabrication.

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Effect of Lower Facial Height and Anteroposterior Lip Position on Esthetic Preference for Korean Profiles

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Objectives : The purpose of this study was to evaluate esthetic preference with modifying Korean average silhouette profiles.
Material and Methods : Korean average male and female profile was modified by changing the lower facial height and the anteroposterior lip position to produce nine types of profiles, respectively. In order to test intrarater reliability, average profile was copied once more. 30 adult orthodontic patients, 30 dental students, 30 orthodontists, and 30 dentists excluding orthodontists were asked to answer questionnaire. In questionnaire, numerical rating scale, which was composed of score 0 to 10, was placed to rate the degree of preference. The data were statistically analyzed by means of intraclass correlation coefficient (ICC), independent t-test, and one-way analysis of variance.
Results : The ICC of overall intrarater reliability was 0.629. In several profiles, significantly higher scores were given to male profiles than female profiles ($p < 0.05$). No significant differences were found in scores for all profiles among four rater groups. In short profiles, significantly highest score was given to retruded profile, and in vertically average and long profiles, significantly highest score was given to horizontally average profile ($p < 0.001$). In all profiles, significantly lowest score was given to protruded profile ($p < 0.001$).
Conclusion : Overall intrarater reliability was good. In several profiles, male profiles were evaluated more esthetic than female profiles. In short profiles, retruded profiles were preferred, and in vertically average and long profiles, horizontally average profiles were preferred. In all profiles, protruded profiles were not preferred.

P-140

Effects of Mini-Implant Assisted Rapid Palatal Expansion(MARPE) on Anatomic Structure of Nasal Area and Respiration

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Introduction : Maxillary transverse deficiency is one of the most common orthodontic problems. Patients with maxillary constriction tend to have narrow airways compared to those with normal maxillary width. In adult patients, rigid interdigitated sutures and mature peri-maxillary structures make it difficult to expand the constricted maxilla. The mini-implant assisted rapid palatal expansion(MARPE) is a simple modification of a conventional appliance, incorporating mini-implants in the palatal jackscrew to ensure the expansion of the underlying basal bone. MARPE not only separates the mid-palatal suture but also enlarges the entire midfacial structure. This poster provides a review of the effects of MARPE on the nasal cavity and respiration.
Discussion : The dimension of the nasal structure (the width of the nasal cavity and nasal floor, the volume of the nasal cavity and nasopharynx) increased after expanding with MARPE. After one year of retention, the width parameter was still significantly wider than before treatment but showed a certain relapse. The volume parameter was retained after two years of retention.
Morphological changes of the nasal cavity impact the airway flow. In computational fluid dynamics analysis, following MARPE, nasal airflow pressure, velocity and resistance were reduced. Furthermore, in the actual measurements of respiration, the maximum inspiratory pressure and the maximum expiratory pressure were increased. This suggests that skeletal maxillary expansion has the potential to enhance respiratory function.
On soft tissues, MARPE impacts, especially on the paranasal area and cheeks. The nose was widened and displaced forward and downward. This change has also increased the volume of nasal soft tissue.
Conclusion : The effects of the mini-implant assisted rapid palatal expansion show the enlargement of the nasal cavity and nasal airway volume. These skeletal changes affect nasal soft tissues and also have a significant positive effect on respiratory functions assessed by airflow and muscle strength.

P-141

Prevalence of Gingival Recession of the Anterior Teeth in Orthodontic Patients

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Objectives : Gingival recession is defined as apical displacement of gingival margins to the cemento-enamel junction (CEJ), which results in root exposure. There has been controversy over the effect of various factors such as age, width of mandibular symphysis, and tooth position. Epidemiologic studies would be helpful to notice prevalence and severity of a disease and can be used to predict the disease progression, risk factors, and treatment needs. The aim of this study was to investigate prevalence and effect of various factors to gingival recession.
Material and Methods : This retrospective cohort study included 29 subjects with gingival recession of the anterior teeth who had visited from March 2019 to March 2021. Patients more than 1 mm gingival recession from the CEJ were selected, while those with generalized gingival recession due to periodontitis were excluded. Lateral cephalograms and intraoral photos before treatment were used, and demographic and cephalometric features were investigated.
Results : The prevalence of gingival recession was the highest in the 30s followed by the 20s and in the mandibular central incisor (76%) followed by mandibular lateral incisor (14%). The ratio of the mandibular to maxillary teeth was 9:1. 69% of the subjects had orthodontic treatment history and showed diverse skeletal patterns. When classified by Miller classification, Class I and II were 59% and 39%, respectively. The average width of the mandibular symphysis was 5.85 mm, which was less than the average value reported previously.
Conclusion : Gingival recession of the anterior teeth was the most common in the mandibular central incisor, which may be related to width of the mandibular symphysis. The high prevalence of orthodontic treatment history may indicate the importance of orthodontic tooth movement within the alveolar bone.

P-142

Analysis of Korean Posts Related to Orthodontics on Instagram and Twitter

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Objectives : The use of social media has increased rapidly in recent years, affecting a wide variety of medical fields including orthodontics. The aim of this study is to analyze the content of orthodontic-related posts uploaded by patients or their family, and to explore potential differences in user attitudes on Instagram and Twitter to investigate patients' perceptions of orthodontics on social media.
Results : The 14 main themes were identified. The three main themes accounted for the most portion on Instagram posts were beginning orthodontic treatment, daily limitations, and finishing orthodontic treatment. As of Twitter, these were daily limitations, wish to start orthodontic treatment, and financial issues. There was a significant difference between the number of positive and negative posts on Instagram and Twitter. Positive posts were over three times as many as negative posts on Instagram, but negative posts were about 1.4 times as many as positive posts on Twitter.
Conclusion : Analyzing patients' posts about orthodontics on social media platforms can help clinicians recognize certain aspects of orthodontic treatment that may not be recognized in their dental clinics. Be aware of the overall differences between the posts on both platforms, and the tendency should be taken into account when accessing and researching orthodontic-related posts.

P-143

Effect of Nicotine on Orthodontic Tooth Movement and Bone Remodeling in Rats

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Objectives : To quantitatively analyze the effect of nicotine on orthodontic tooth movement (OTM) and bone remodeling in rats using micro-computed tomography and tartrate-resistant acid phosphatase immunostaining.
Material and Methods : Thirty-nine adult male Sprague-Dawley rats were randomized into three groups: group A, 0.5 mL normal saline (n=9, 3 per 3, 7, and 14 days); group B, 0.83 mg/kg nicotine (n=15, 5 per 3, 7, and 14 days); and group C, 1.67 mg/kg nicotine (n=15, 5 per 3, 7, and 14 days). Each animal received daily intraperitoneal injections of nicotine/saline from the day of insertion of identical 30-g orthodontic force delivery systems. A 5-mm nickel-titanium closed-coil spring was applied between the left maxillary first molar (M1) and the two splinted incisors. The rate of OTM and volumetric bone changes were measured using micro-computed tomography. Osteoclasts were counted on the mesial alveolar bone surface of the distobuccal root of M1.
Results : All six dependent outcome variables showed no statistically significant among group-differences at 3, 7, and 14 days. However, the maximum M1-M2 was observed on day 14 in group C, while the least was observed on day 3 in group A. According to the descriptive statistics, the OTM rate in the control group gradually increased at regular intervals over time. Compared with the control group, the nicotine groups showed a fluctuating OTM rate over the observation period . The lowest values for the bone volume fraction, bone mineral density, and trabecular thickness were observed on day 14 in group C. On day 14 in group C, the number of osteoclasts showed a tendency to increase coincided with the maximum M1-M2.
Conclusion : The findings of this study suggest that nicotine does not affect OTM and bone remodeling, although fluctuations during the different stages of OTM in the nicotine groups should be elucidated in further prospective studies.

P-144

The Accuracy of Intermaxillary Relational Measurements in 3D Printed Models: Based on Inter-Operator Reproducibility

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Objectives : Digital models have been recently used in orthodontic clinics, but physical models are needed for many reasons. Many reports have been issued on the accuracies of printed models, but few studies have evaluated the accuracies of reproduced inter-arch relationships. The purpose of this study was to evaluate whether the printed models can replace the plaster models by evaluating the accuracy of the intermaxillary relationships of the printed models and the clinicians' ability to measure the printed models.
Material and Methods : Twenty sets of patients' plaster models with good occlusal relationships and conditions were selected. Models were scanned using an intraoral scanner (Trios 3, 3Shape Dental System, Copenhagen, Denmark) by one operator. Printed models were made with ZMD-1000B light-curing resin using the SLA method 3D printer (Dentis Co., Seoul, Korea). Validity, reliability, and reproducibility were evaluated using measurements obtained by three operators.
Results : In the validity evaluation, no items showed significant differences between measurements taken from plaster and printed models. In the reliability evaluation, significant differences were found at #23-#33 (DZL_3) for the plaster models and at #17-#43 (DZCM_1) for the printed models. In the reproducibility evaluation, the plaster models showed significant differences between operators at midline, and printed models showed significant differences at 7 measurements including #17-#47(DZR_7).
Conclusion : The validity and reliability of inter-arch relationships as determined by the printed model were clinically acceptable, but the reproducibility revealed significant inter-operator differences. In order to use printed models as substitutes for plaster models, additional studies of the accuracies of intermaxillary relationship are required.

P-145

Clinical Application of Digital Virtual Articulator in Orthodontics

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Introduction : For the success of orthodontic treatment, accurate evaluation of occlusal relation is needed. Especially for the patients with unstable occlusion, not only analysis of static occlusion using dental cast but also analysis of dynamic occlusion and mandibular movement using articulator is needed. Evaluation with the use of conventional articulator, however, requires several complex laboratory procedures such as face-bow transfer, bite taking, mounting with plaster which can increase the possibility of the error. The purpose of this report is to introduce a digital articulator utilizing digital technique which has high-reproducibility and high-accuracy.
Case Summary : A 48-year-old man was referred from the department of prosthodontics for the evaluation of centric relation occlusion (CRO) - maximal intercuspation position (MIP) discrepancy and denture midline discrepancy caused by mandibular angle and condylar head fracture from a traffic accident. For the rehabilitation of stable posterior occlusion and prosthodontic treatment, occlusion and condylar position was evaluated with the digital virtual articulator. A cone-beam computed tomography (CBCT) scan of the patient was obtained in MIP, and the maxillary and mandibular casts were scanned both in CRO and MIP with an intraoral scanner. Change in mandibular position was also evaluated in both CRO and MIP by superimposing the data of each mandibular position. Condyle position of CRO and MIP was obtained by integrating the model scan data in CRO and MIP on the CBCT image and quantitative measurement was obtained with the grid.
Conclusion : With the use of digital virtual articulator, accurate assessment of occlusion and condylar position is possible. Digital technique is efficient for both patient and practitioner. At the same time, it decreases errors by eliminating complexed procedures needed for the conventional method.

P-146

Combined Treatment of Surgery-first Approach and Clear Aligner for Mandibular Prognathism Correction

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Introduction : The recently introduced surgery-first (SF) approach in orthognathic surgery is popular among patients owing to the immediate improvement of the facial profile and shorter treatment time unlike with the conventional 3-stage approach. Clear aligners are gaining popularity in the orthodontic market because of their transparency. Their use during postoperative orthodontic treatment with the SF approach enables complete esthetic treatment without brace attachment. Moreover, an immediate improvement of the facial profile and expedited tooth movement could be achieved.
Case Summary : This case report introduces a treatment innovation in mandibular prognathism correction by combining the SF approach and clear aligners. An intraoral scanner and a virtual setup program were used for treatment simulation. All clear aligners were fabricated using a 3-dimensional printer. The patient underwent Le Fort I osteotomy and mandibular setback surgery using bilateral sagittal split ramus osteotomy without any preoperative orthodontic treatment. After 2 weeks of intermaxillary fixation, a guided splint was used for 1 week for more stable occlusion. Three weeks after the surgery, postsurgical orthodontic treatment was started using clear aligners. The total treatment was completed within 3 months after surgery.
Conclusion : An immediate improvement of the facial profile was obtained using the SF approach, and rapid and esthetic tooth movement was achieved using the clear aligners. This case report demonstrated that the combination of the SF approach and clear aligners could be a patient-oriented surgical-orthodontic treatment method.

P-147

Clear Button Design in Tube Appliance Orthodontics: Clinical Proposal

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Introduction : The mini tube appliance, which is recently used a lot in orthodontic treatment, has many advantages, but it is a treatment method with limitations. Among them, when using an intermaxillary rubber band or attaching an attachment that allows elastomeric application, the detachment is high or it is not easy to attach to a desired location. An easy way to attach a button on the tooth surface using an o-ring for separation introduced in 2020 by Esequiel E. Rodríguez Yáñez.
Discussion : Since the button mold method or the ready-made clear button has a flat base, it had to be attached by changing its position toward the cervical area or incisal area away from the tube appliance. However, this method can be attached by stacking the base with bonding paste on the tube appliance, and can apply the elastomeric orthodontic force in the vertical and horizontal directions as well as the insertion and removal of wires
Conclusion : .The use of intermaxillary elastic bands or elastomerics to achieve better teeth positioning in partial orthodontic appliances will result in better treatment outcomes. But, there were limitations in button attachment, which had a high detachment rate due to weak adhesive strength, or was difficult to attach to a desired position. A novel approach was devised for easy attachment to tube orthodontic devices. It is hoped that a rubber band can be used at the location where the tube is attached, the patient can maintain adhesion when the rubber band is installed, and it is aesthetically pleasing and the additional cost is low, so it is of great help to clinical practice.
We introduced a simple and easy way to use an intermaxillary elastic band in tube appliance orthodontics.

P-148

Protocol for the Management of Open Bite Malocclusions with the Shark-Tooth-like Spurs (JAWs)

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Purpose : The purpose of the present study was to introduce a protocol for the management of AOB of different severity using the custom-made Shark-Tooth-like Spurs (JAWs) as the habit appliance for eliminating tongue-thrusting.
Materials and methods : The study included 36 participants (20 females, 16 males) with an average age of 14.5 years (SD± 3.3 years) that were diagnosed with AOB. Subjects were subdivided into mild (12), moderate (14), and severe (10) groups based on the severity of AOB. JAWs were the only appliance used during the first phase of treatment to correct the tongue-thrusting habit. JAWs of standardized sizes (3.0 mm) were made from compomer cement and bonded on the lingual surfaces of the maxillary and mandibular anterior teeth. Lateral cephalograms were taken before (T0) and after three months (T1) of treatment with JAWs. Paired t-test was used to evaluate the dentoalveolar changes and one-way ANOVA was used to compare the AOB changes within groups. Significance was set at P
Results : No statistically significant changes in skeletal variables were observed among the groups. The overall overbite was improved combined with a lingual version of both maxillary and mandibular incisors was observed. No significant difference in the amounts of AOB correction between the mild (1.9 ± 0.5 mm), moderate (2.1 ± 0.7 mm), and severe (2.3 ± 0.7 mm) groups was observed. However, significant differences in the percentages of overbite reduction between the mild (91%), moderate (46%), and severe (25%) AOB groups were observed (P <0.01).
Conclusions : The use of JAWs is effective in the correction of tongue thrusting habits, and improvement of AOB. Further studies are necessary to evaluate the effect of JAWs of different sizes in the management of AOB of different severity.

P-149

Comparative Study of the Fit between Ready-made and Customized 3D Printed Chin cup

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Objectives : The purpose of this study was to evaluate the fitness between ready-made and customized 3D printed chin cup to the skin by using a simple application and 3D software.
Material and Methods : The subject consisted of 5 adult volunteers(3 males and 2 females). The whole face of the subjects was digital-scanned by an application focused chin area of the subjects. A customized chin cup was fabricated with the outer surface of the digital-scanned ready-made chin cup and the digital-scanned surface of the subjects' chin. After printing the customized chin cup using a 3D printer, the customized chin cup was reinforced with resin to withstand orthopedic force. Pressure indicator paste was applied on the inner surface of both customized and ready-made chin cup. All subjects were instructed to wear both customized and ready-made chin cup for 10 minutes each with a force of 500gm per side. After that, the contact area of each chin cup was measured to evaluate the fitness to the skin.
Results : Customized chin cups showed a wider contact area than ready-made chin cups. Contact areas were mainly concentrated on the edges of the inner surface in the ready-made chin cups, while customized chin cups showed broad and wider contact areas.
Conclusion : The customized chin cups showed a wider contact area and well suited to the skin than ready-made chin cups. With the development of 3D technology, if the cost-effectiveness is solved when manufacturing customized chin cup, uncomfortableness such as redness and itching caused by traditional chin cup can be dramatically reduced.

P-150

Automatic Detection of TMJ Osteoarthritic Bone Changes Based on Artificial Intelligence Using Faster R-CNN

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Objectives : This study is to develop a tool for automatic detection of the characteristic bony changes of mandibular condyle in TMJOA patients using artificial intelligence.
Material and Methods : A total of 1,094 sagittal CBCT images collected from TMJOA patients and non-TMJOA subjects were classified into three groups and labeled as 'No OA', 'Indeterminate' and 'TMJOA'. Faster Region-based Convolutional Neural Network model was used in training with these images. The performance of the trained model was evaluated with 127 test images using metrics. Another model was also trained with 2-class train dataset. 'No OA' group and 'Indeterminate' group were merged into 'Control' group and the images of the train dataset were labeled as 'Control' group and ' TMJOA ' group. This second model was evaluated with the same test images as in the 3-class model evaluation. With the 127 test images, performance by a human observer, who had more than 10 years of experience in orthodontics, was also measured.
Results : The accuracy, F1 score and mAP of the 3-class trained model were 70.9%, 70.2% and 79.1% respectively. This model tended to be confused in discriminating between ' No OA ' group and ' Indeterminate ' group.
However, if these two groups were merged into one group as 'Control' group and the images were classified into a total of two groups ('Control' group and 'TMJOA' group), the newly arranged test results increased the accuracy and F1 score to 91.3% and 90.5% respectively. The accuracy, F1 score and mAP of the second trained model of 2-classes were 93.7%, 93.0% and 95.5% respectively. These models showed better or at least comparable performances compared to the human observer.
Conclusion : It is possible to detect the characteristic bone changes in TMJOA on CBCT slice images with Faster R-CNN model. The models in this study are excellent detectors of bony changes in TMJOA.

P-151

Short-term Changes of Lower Anterior Facial Height and Incisors after Anterior Bite Raising

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Objectives : Improvement of deep bite is one of the most difficult processes during the orthodontic treatment. By bonding bite-raising appliance on the lingual surface of upper anterior teeth, it is possible to improve deepbite more conveniently and quickly. In a previous study, when a deepbite was treated using an anterior bite raising, it was shown that intrusion of mandibular anterior teeth was achieved without a vertical increase in the facial height. However, it was not known about the tooth movement immediately after the anterior bite raising, so we studied the initial vertical changes of the face and incisors.
Material and Methods : Tracing was carried out on 30 patients who underwent comprehensive orthodontic treatment with full fixed appliances in our clinic. Lateral cephalograms were taken before the anterior bite raising, right after the bite raising, 1 month later and 3 month later. Lower facial height, mandibular angle and vertical position of upper and lower anteriors were traced.
Results : A significant portion of the anterior facial height and mandibular angle increase due to anterior bite raising decreased again within 1 month, and most of the mandibular incisor intrusion occurred within 1 month. Thereafter, small changes continued up to 3 months.
Conclusion : Intrusion of mandibular incisors and regression of increased anterior occlusal height through anterior bite raising were largely achieved within 1 month.