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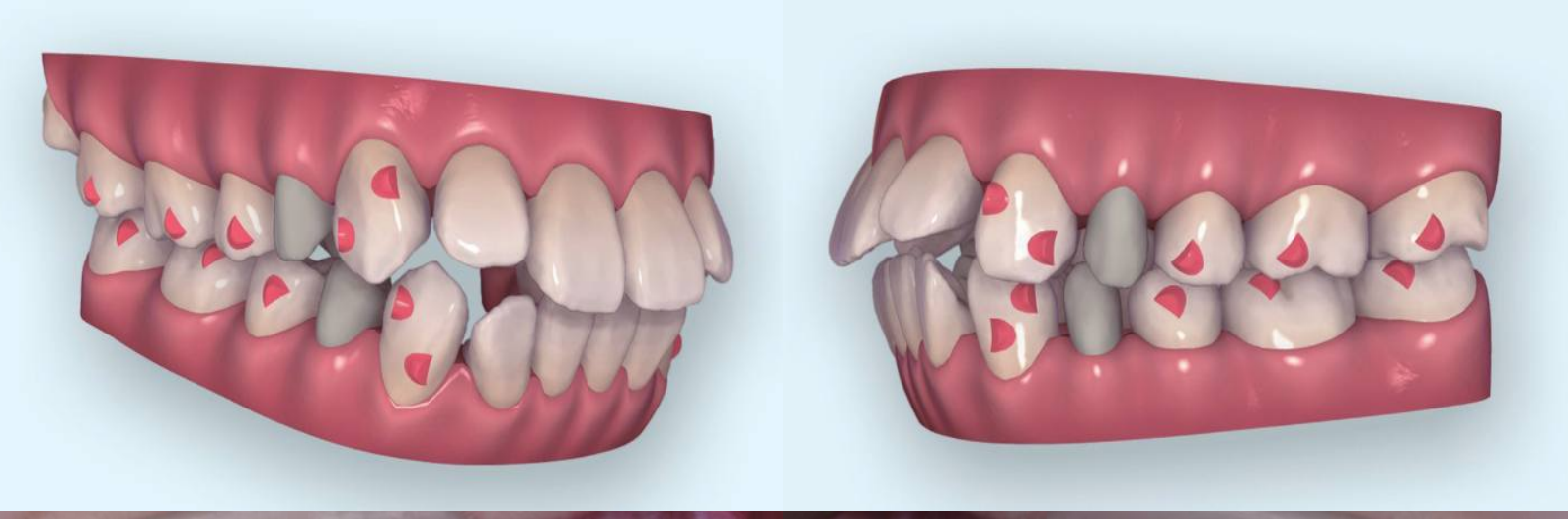
JCDD

Journal of Clinical & Digital Dentistry



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JCDD
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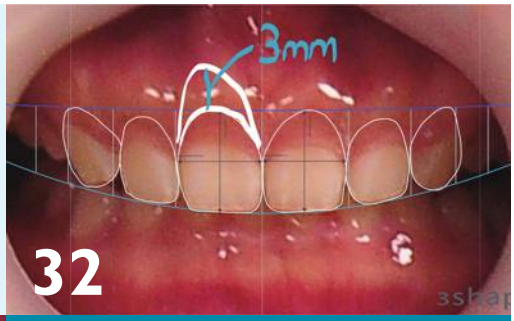

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About the Journal

The Journal of Clinical and Digital Dentistry are published four times (March, June, September, and December) annually since May 2019. The abbreviated title is "J Clin Digit Dent". In the journal, articles concerning any kind of clinical dentistry such as prosthodontics, orthodontics, periodontics, impl ant dentistry and digital dentistry are discussed and presented.

Aims and scope

This journal aims to convey scientific and clinical progress in the field of any kind of clinical and digital dentistry.

This journal publishes

- Original research data and high scientific merit in the field of clinical and digital dentistry.
- Review articles.
- Case reports in implant dentistry including GBR, digital dentistry, 3D printing, and prosthodontics.
- Short communications if they provide or document new technique and clinical tips.

About the Journal

Editorial Board

Editorial

Enjoy your Dentistry!

If you find joy and satisfaction in life through your career, you're probably the happiest person in the world. When I watch my patients' health improve and live long and happy lives, I'm reminded that my work is worth keep pursuing. I've also found much significance in involving myself with dental industries that enable dentists to provide their patients with the best possible treatments.

Unfortunately, the reality is that many dentists regularly face enormous stress from not only the difficulties of clinical treatments, but also their relationships with their patients. It's perhaps because of the differences between the clinician and the patient about the perception of what constitutes beauty and functionality; and the fact that a clinician's role is to nevertheless provide the patient with satisfactory results in both areas.

With the implementation of CAD-CAM, the field of dentistry is undergoing changes in ways that are different from the past. However, it's uncertain as to whether that change can be considered a qualitative improvement. It's perhaps better described as a change in treatment methodology.

JCDD will endeavor to play a role in enabling the development of clinical dentistry through CAD-CAM and various digital technologies in order to help our patients' health and esthetic appearance.

I hope that our work will help every dentist find joy and satisfaction in their practice.

Sincerely

Wongun Chang, DDS MS PhD

Panel Discussion - on the First Issue of JCDD

On the role of JCDD for the present and the future of dentistry

Editor-in-chief

Wongun Chang, DDS MS PhD

DDS, Seoul National University College of Dentistry

MS, New York University(NYU) College of Dentistry

PhD, Seoul National University College of Dentistry

Certificate, Advanced Education Program in Prosthodontics, NYU College of Dentistry

Vice President, Korean Academy of Esthetic Dentistry, Korean Academy of Stomatognathic Function and Occlusion

Director, Milestones Dental Institute, Seoul, Republic of Korea

Deputy editor

Dongwoon Lee, DDS MSD PhD

DDS, Wonkwang University College of Dentistry

MSD, Wonkwang University College of Dentistry

PhD, Korea University College of Medicine

Certificate in Periodontics, Dental Hospital of Veterans Health Service Medical Center

Visiting Scholar, Department of Advanced Periodontics, University of Southern California, Los Angeles, CA

Board Member, Korean Academy of Periodontology

Board Member, Korean Academy of Esthetic Dentistry

Chair & Faculty, Department of Periodontology, Dental Hospital, Veterans Health Service Medical Center, Seoul, Republic of Korea

Deputy editor

Kwantae Noh, DMD MSD PhD

DDS, Kyung Hee University School of Dentistry

MSD, PhD, Kyung Hee University School of Dentistry

Certificate in Prosthodontics, Kyung Hee University Dental Hospital

Clinical Instructor of Asan Medical Center, Seoul, Republic of Korea

Visiting professor in Tokyo Dental College

Associate Professor of Department of Prosthodontics, School of Dentistry, Kyung Hee University, Seoul, Republic of Korea

Chang: I'm very honor to have Prof. Dongwoon Lee and Prof. Kwantae Noh as deputy editors of JDCC and thank both of you very much for being here. JCDD begins its publication to look into the future of dentistry based on the past and the presence and to work for the development of clinical dentistry and digital dentistry with dentists all over the world. Although there is so much knowledge on the web and the social media nowadays, as well as many journals, I hope that JCDD will be able to perform a certain role and today I also want to talk about changes in dentistry in the coming future and the role of JCDD.

Noh: I'm very happy to have a good clinical journal in the field of dentistry. I hope that this journal can provide useful information to many clinicians.

Lee: Thank you very much for giving me this opportunity. I'd like to take this opportunity to pay attention to the basics and complications, and learn from cases while many distinguished colleagues from many areas play their role. I hope that JCDD will become a venue to check the basics, although the latest things are also important.

1. What are the current trends in dentistry?

Chang: First, I'd like to talk about the current trends in dentistry in 2019. I'd like to hear what both you think are the current trends in dentistry as a clinician and an educator.

Lee: I believe "less invasive" will be the keyword. I believe it's important to provide less invasive treatments in not only digital impression but in surgical areas such as using a guide.

Chang: I agree with the keyword "less invasive." It is true that "less invasive" is getting more and more emphasized in not only implant surgery but also prosthetic treatments and ceramic restorations.
As a trend on a slightly different aspect, I'd like to talk about what is related to clinical training. If training mostly happened in off-line seminars in addition to a small number of hands-on courses, I believe that in the future, it is changing to the way that on-line training is becoming mainstream and hands-on training that is lacking in on-line training is being supplemented.

Noh: Nowadays it seems to be changing into the age where people can see much dentistry related information on-line and listen to lectures of world-renowned clinicians on-line conveniently. As you mentioned, I believe that from now on, on-line education will become more and more active in dentistry with the exception of required hands-on lectures and various contents will be developed. The trend I think of would be "digital". The change to digital dentistry has already begun, and will be emphasized more, I believe.

Lee: From the technical point of view, if we educated people by looking at technical notes in the past, I believe now that the role as an educator that determines what to select and educate from numerous contents. As a matter of fact, embedding a code in a journal and linking it to a video has been utilized a lot. I believe this is one of the directions JCDD should take.

Chang: Recently, I heard that many dentists who began digital dentistry complain that "as digital dentstry becomes popular, there are many roles a dentist must fulfill, and it's very inconvenient because it takes more time and dentists are busier compared to when we requested to dental technicians after taking analog impression." The current trend to digital dentistry should take us to the direction that not only saves time from the perspectives of dentists and dental technicians but also improves the environment of dental clinics and dental technical laboratories, as well as the quality aspect of treatment, but as digitalization is currently under development, there are some people who express their discomfort as compared to the analog age. Such issues we must continue to think about in the near future.

2. How will the current trend evolve and change in the future?

Chang: I think everybody agree that digital dentistry is the biggest trend. I wonder how it will evolve and change.

Noh: I feel that the current dentistry is really rapidly evolving to the point that we find it hard to catch up. As we combine digital technologies in our treatments, treatment methods we could not attempt to the past are now possible, and we've seen many changes in communication with dental technicians. We still have a long way to go, but I believe such digital technologies will become more and more familiar to clinicians and bring changes to dental clinics.

Chang: Although we can't change such trends, I believe it is important that we don't forget the basic treatment goals such as functional occlusion and stomatognathic harmony. I believe that emphasizing dental technics and treatments using digitalization while understanding on tooth anatomy and occlusion is lacking is putting the cart before the horse. Especially in case of prosthodontic treatment, all patients have different occlusion and mandibular movements and what they are accustomed to are different, so there are certain areas where you just can't work on mechanically, so I believe that one should not miss the point that combining with digitalization must be preceded by studying and cultivating competencies in the basics of dentistry.

Lee: I couldn't agree with you more. The word "digit" itself has the meaning "fingertip" and there are certain things you must learn to do by hands whichever treatment you do. As people tends to acquire knowledge easy and fast beyond the basics, they find it hard to deal with whenever there is a problem. In this age, we need to educate people the basics. I believe there is the trend of substituting what is lacking in skills with the development of the materials. We must continue to provide the venue for learning the basics.

3. What are the challenges that digital dentistry currently needs to address?

Lee: We must avoid the tendency to overcome the basics with the development of technologies and materials. We need to have the venue to teach the basics while we are progressing into a good direction, and pioneers needs to contribute to this role through JCDD in the flood of contents.

Noh: As you mentioned, I believe digital technology must not evolve into the direction of just providing treatments simply fast and easy. Above all, what is important in clinical dentistry is treatment outcomes.

Chang: Although young dental technicians learn digitalization easy and fast, but middle-aged or older technicians who used to do their work in analog methods find it hard to learn and apply digitalization. Of course, the same could be said about dentists. However, when we look from the point of view of their works, the meister technicians who do their work using analog methods still show much better results. The current atmosphere instigating that not catching up with digitalization is to go out of date is not good. However, if we can't avoid having everything digitalized, I believe software, etc. must be developed so that even people who are computer illiterate can approach digitalization easily.

Lee: When we achieve our ability and knowledge as dentist, we must prepare a lot and give a lot. I believe it's problematic when we just want to follow the trend too quickly without validation.

Chang: It's regrettable that masters of the digital age are recognized for how well they handle software. This is different to being an excellent doctor.

Lee: The beginning is the patient and the end is also the patent. What is problematic is that digitalization in Korea begins with software in the middle and ends with software. We must take a look at this once again with critical thinking.

Chang: As previous CAD/CAM companies developed and sold their equipment as dental clinic in-office systems, dental clinics began to do much dental technician work and because of this, sales of dental laboratories decreased and a new problem began to emerge.
When we look at this from the perspective of the entire dental world, we must combine digitalization in a way that dentists and technicians both can have a win-win relationship. It should not be absolutely necessary to develop into the way to perform dental laboratory work in dental clinics, but it is necessary to have better communication with dental laboratories during treatment and fulfill each other's role well.

Lee: The digitalization we think of seems different to achieve our knowledge. It feels like if we create outcomes fast, we are moving forward way too fast.

Noh: The beginning and the end of treatment is the patient. The goal of dental treatments is to provide good treatments to the patients so that they can have stable occlusion with aesthetic for a long term. It is important not to miss this point even in the developing dentistry. Therefore, we must take a caution against dentistry education leaning too much towards the technical aspects.

Chang: As we rely on CAD/CAM excessively, the number of malocclusion related TMD patients is increasing and also there is an increasing number of patients who receive retreatments due to discomfort or pain after getting treatments.

4. There are also opinions that the analog clinic of the past was more convenient and better than the current digital clinic from the perspective of the operator. What do you think about the directions of the analog and the digital?

Chang: As you mentioned briefly earlier, in the past dentists just confirmed all the work that had been done at laboratories, but now dentists and technicians together can check and give treatments in each step with either sharing or remote control of digital software, so we should move to a direction where such advantages can be utilized well.

5. Are clear aligners the future of orthodontics?

Noh: There are many cases many rehabilitation patients can do pre-treatment orthodontics with clear aligners to lead to better treatment outcomes. Although orthodontics is not my specialty, I believe dentists can approach orthodontics a little easier by clear aligners and apply them to patient treatment.

Chang: Currently Korea shows the trend to view clear aligners more negatively than other countries. However, when you see the fact that the annual sales of the clear aligner market such as Invisalign, has already surpassed other dental fields, I believe more treatments will be done by clear aligners in the future.

Lee: I often wish that clear aligners should be applied to the areas where the teeth needs to move more in the periodontal area. I think this will have a wide range of application.

Chang: Diagnosis using digitalization, clear aligners, customized bracket making and indirect bonding are the digitalization in the field of orthodontics. There have been continuing changes in the 100 years of history of orthodontics. As new brackets and wires have been developed, treatment methods have continued to change. I think that there will be even more changes in treatment methods in the future through clear aligners. Orthodontic treatment through clear aligners will be popularized more and more. Also, for tooth movement from the treatment perspective of periodontists or orthodontists, I hope that clear aligners will be utilized very much and interdisciplinary approaches can be implemented more effectively.

6. Prosthetic treatment has not shown big changes in either the treatment goal or the processes. What kind of changes can we expect to see?

Chang: As we mentioned earlier, although orthodontics has seen continuous changes and development in treatment methods for treatment goals, but prosthetics has not. What changes do you expect from the development of digital dentistry in the future?

Noh: Recently real rapid changes are happening by applying digital technologies in prosthetic treatment. There are many benefits to applying digital technology in restorative treatment. Communication with dental technicians becomes easier than before, and the making of restoration becomes predictable and easy. Also, easy re-production becomes possible through saved information.
Another advantage is to be able to make prosthesis from much information of a patient by fusion of digital information. For example, information from a patient's face scan, CBCT, and mandibular movement path can be merged in one place, diagnose the patient and design a suitable prosthesis for the patient.
Also, this has become an era immediate loading, dentures and intraoral devices can be designed and printed. 3D printing will be applied in more restorative fields as printing materials evolve.

Chang: As it was necessary to make a prosthesis that can perform the same function both outside and inside of the oral cavity, there have been developments such as an articulator to reproduce the mandibular movement. Currently digitalization seems more concerned with making final prosthetic restorations, but I believe there will be more development in diagnostics through 3-dimensional reproduction and recording of mandibular movements and combination of the acquired data.

Lee: I envision that plaster and impression material will disappear. Currently the benefit is to combine information through digital impression while periodontics introduces digital measurement to soft tissue. I think currently the research direction will be changed to the way the volume change in soft tissue is measured without taking impression. When we see it from the clinical point of view, I think it might develop into various ways.

Chang: In the past, we had to consider impression contraction. Now this is the age combinations of certain scanners and certain printers are important.

7. Changes in implant dentistry through guided surgery

Chang: I believe making guides for implant surgery is where digitalization is the most popularized. What do you think of the changes or developments for this in the future?

Lee: First is already experiencing situations we need to deal with during a surgery through actual simulation before a surgery, so I think this can reduce complication during a surgery significantly. Some people say it takes much longer, but I think this is the time to reduce complications that can happen.

Noh: To perform an implant guide surgery, the operator must make additional efforts such as making a diagnosis and designing a guide, but I believe there is the advantage of reducing the surgery time. Especially, it is advantageous to place the implant in the three dimensional correct position considering prosthesis, therefore this offers many advantages to both the operator and the patient. Especially when a immediate restorations are planned with an implant surgery in edentulous cases, surgical guides do help a lot, so I think it will gradually become common.

Chang: Not only determining the position of an implant surgery through a guide, flapless surgery based on a guide does have benefits, I believe. But the problem is who has to take the responsibility in determining the position for implants during making a guide. As the dentist takes the responsibility for treatment, I think the role of the dentist in making a guide is needed the most. It should not be just simply confirming the information provided by a guide manufacturer through 2D information, but I think the correct way is dentist doing it directly during the process of deciding the implant position. In that context, I think we should change into the direction we design and print guides in dental clinics directly, or subcontracting only printing service after designing guides directly.

Lee: I think operators who perform guide surgeries may not be able to feel the situations they can feel with their fingertips. It's important for those who have less experience in surgery should make a habit of checking various situations during a surgery. I think problems may occur in terms of long-term complications while pursuing a little convenience.

Chang: You're Right. The same could be said about orthodontic treatment. Any operator who get used to indirect bonding may find it difficult to do bracket bonding on a real patient directly. I think this is the same as the difficulty in remembering directions and driving as the navigation system of automobiles evolves, or people getting lost because they can't remember phone numbers because of smartphones.

Lee: I think using digitalization from the perspective of pre-evaluation and diagnosis is important. Also, making block bones, mesh and membranes fitting the shape of defect areas by printing will also evolve. I think there will be development in bone printing also.

8. What further development does implant industry need?

Chang: What further changes should be needed in not only guides but also implant dentistry? Personally, I think there must be more development in diagnosis. When we say diagnosis, we often think about implant positions, GBR, etc., but in my opinion, if it was the problem of the interpretation of "what has led to extract teeth and perform implant treatment?" and if this was a problem caused by occlusal incongruity, I think a diagnosis for the cause, the treatment plan for the cause, and systemization of the treatment process to ensure that the same problem in the natural teeth will not occur after implant restoration.

Guide, bone graft, diagnosis, integrated diagnosis,
Each participant summarizes the development direction of implant.

9. Development and popularization of full dentures and removable dentures

Noh: I think in removable dentures, technical processes will change into CAD/CAM in many areas. Digital dentures may reduce many errors in traditional denture making processes. Also communication with dental technicians become much easier. There is another advantage of easy reproduction when a patient loses denture or denture is broken because patient data is saved.

When printing materials and technologies are developed and milling speed is improved, I think digital dentures will be popularized more and more.
However, I don't think that clinical procedures such as obtaining impression, bite registration, etc. in denture. Therefore, learning the basics of clinical techniques will still be important even as digital technologies evolve.

Chang: You're right. As you said, being able to make a new denture before a patient visits a dental clinic in case of loss or fracture and provide it right away to the patient is a big benefit to patients, I think. Data from existing dentures will provide convenience to operators also.

10. What would be certain areas that need to be developed along with the current trend?

Chang: as digitalization is being developed, we are doing much equipment marketing to the general public, but I think it is important to emphasize that treatment by dentists, diagnosis and treatment plan are important above all, because it's not the equipment doing the actual dental treatment. We need to correct the false impression that dental treatment is just techniques, so good treatment can happen if the equipment and materials are excellent, rather than the skill of the dentist. This simply needs to be emphasized to not only patients, but also dentists as well. We need to go back to the basics and it's important to recognize the important role dental treatment plays in the life of a patient and how hard and important dental treatment is in changing everyone's different teeth and oral environment in a healthy and aesthetic way.

Noh: I think we need a venue for communication for clinicians to determine what is good and what is bad, and also to provide good educational contents in this age of much technical progress and flood of information.

Lee: We need to play certain roles to make sure that people do not miss the basics, the basics of practices.

11. If there are new changes or a blue ocean in the field of dentistry or a blue ocean, what fields would this be, and where?

Chang: I believe dental treatment related to sleeping could be the new blue ocean, although there had been understanding of its importance in the past. We need researches on the impact of sleep-related phenomena such as sleep apnea, snoring, bruxism, clenching, etc. on the health of the whole body and effective oral devices to solve such problems. I think as oral devices such as anti-snoring devices are being popularized, they will expand into a new domain, not just teeth.

12. What role should JCDD play in the development of future dentistry?

Chang: Now, what kind of a role do you expect the newly launched JCDD should play in the development of dentistry, like the topic of today's panel discussion?

Lee: I think JCDD should play the role of ensuring that we don't lose the true role of practice and knowledge themselves, rather than trying too much to catch the latest trend. I'd like it as a soft magazine-like journal that people can take a peek at the latest trend, build basic knowledge and read comfortably once in every three months. I hope that it will become a venue where anybody can participate and share clinical reports comfortably.

Noh: I hope it will introduce many clinical reports that do not miss the basics of clinics while reflecting the latest trend, and grow into a journal that helps clinicians.

Chang: Like you can't know what a person thinks if the person does not speak, I hope this will become a journal that helps to implement the most suitable treatment plan for each patient obtained through the diagnosis of dentists through digitalization as it is. I hope that dentists all over the world await March 17, June 17, September 17 and December 17, when the journal is published, and this becomes a magazine to deliver the fundamentals of dentistry and the latest knowledge through the journal.

Thank the two of you again for having this conversation for a long time today and I look forward to creating a new history together.

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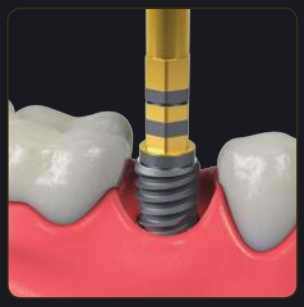

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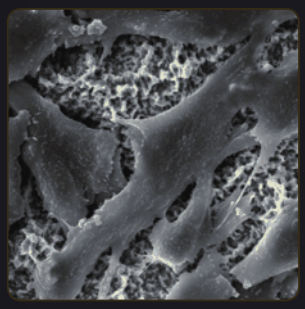

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Premolars extraction protocol in CAD/CAM clear aligner therapy

Kwai Hung Chung, DDS, MSD

Introduction

In 1997, Align Technology Inc introduced Inivisalign, a series of clear removable appliances, as an esthetic alternative to fixed labial appliance[1]. Clear aligner appliances have been available for more than 70 years, with the earliest examples made from an individual tooth set-up with a single vacuum-formed appliance made from this appliance. Align Technology made Kesling's proposal in 1945 much more practical[2].

The workflow is simple in modern technology. When a case is suitable for treatment, patient teeth are scanned, a 3-dimensional model is created, and the computer performs virtual treatment using CAD/CAM technology. The clinician can access this treatment plan and modifies it until it is acceptable. Creation of an aligner involves computer-aided-design and computer-aided manufacturing CAD/CAM stereolithographic technology to fabricate a series of aligners that sequentially move teeth in small increments[3].

Digital technology allowed clear aligner treatment techniques to be used in orthodontics worldwide. The Clear Aligner Therapy (CAT) is increasing in popularity given its advantages over conventional fixed appliances in terms of esthetics, oral hygiene, comfort for patients, shortened chair time in mild to moderate cases, despite the higher costs and the unpredictable outcome in certain cases[4].
Several companies offer a complete digital workflow, from scan via software-controlled tooth movement to robot-controlled aligner manufacturing. These CAD/CAM appliances have been available to the orthodontic market over a decade with more than 6 million patients have received treatment already[18].

Unfortunately, research on orthodontic tooth movement using clear aligners is limited. Most of the literature consists of case reports, editorials and very limited number of randomized clinical trials (RCTs) have been done[5]. Few evidence-based researches attempt to describe the type of orthodontic tooth movement resulting from treatment with clear aligner therapy[6,7,8].

Clear aligner proves to be a good pushing appliance to provide dental expansion (arch development), molar distalization and opens up space for the dental implant site. Upper molar distalization revealed the highest predictability (88%)[6,7,9]. The mean accuracy of expansion planned with clear aligner for the maxilla is 72.8% and for the mandible is 87.7%[10]. Invisalign is generally able to achieve predicted tooth position with high accuracy in non-extraction cases[11]

What about extraction cases? There are enormous differences in orthodontic extraction frequency worldwide varies within a range of 6.5% to 83.5%[16]. The prevalence of dental protrusion is high in China. As a result, the rate of premolar extractions is also very high among orthodontic patients in China at about 60%[17]. Asian patients benefit from extraction therapy from esthetic point of view, as they tend to show protruded lip positions and crowding, which might lead to better aesthetic results with extractions. Extraction treatment increases the inclination of the chin and reduces protrusion of the lower lip compared with non-extraction treatment[17].

The exact biomechanical mechanisms by which clear aligner exerts its effects remain unknown, and it is difficult to assess the force imparted by these clear aligners. Extraction are possible with the aligner system[12,13,14]. But it may be extremely challenging to finish well with clear aligners. Teeth adjacent to the premolar extraction sites tend to have significant tipping at the end of aligner treatment[15].

Kwai Hung Chung

Dr. Chung Kwai Hung qualified from The University of Hong Kong in 1994. He has postgraduate orthodontic training in New York University and Jinan University in Guangzhou China. He obtained a Master of Medical Science in Orthodontics from Jinan University in 2013. He is currently member of Chinese Orthodontic Society, member of American Association of Orthodontist, Fellow of World Federation of Orthodontist. He maintained a private practice in Hong Kong.

There is no universal extraction protocol for the clear aligner therapy. Most clinicians have to rely on the opinion of experts and their own clinical experience.

I would like to share my experience in treating extraction cases using clear aligner therapy. To ensure successful premolars extraction treatment with clear aligners, case selection is the starting point. Case selection is critical for the success of premolars extraction cases with clear aligners. The ideal case for 4 premolars extraction to start is bimaxillary protrusion with long clinical crown, mild to moderate crowding and minimal overbite because it is relatively easy to maintain proper incisors torque and overbite. Cases with deep bite, retroclined incisors and short clinical crown should be avoided as incisor torque is very difficult to correct and maintain. Bite will deepen during incisor retraction. It will either take a very long treatment time to finish the case or auxiliaries like TAD, even fixed appliance is unavoidable.

There are three commonly used premolars extraction space closing protocol.
The conventional one use long vertical rectangular attachment on canines, premolars and first molars to control their root tip during closure of extraction space, retract canine few steps ahead of incisors and then en masse retraction. The second one is what we call caterpillar tooth movement/staggered staging technique to control tooth movement and tipping by sequencing which teeth were moving at any particular time[19]. The third one is the Invisalign G6 maximum anchorage protocol.
I personally preferred the first and second one which use rectangular attachments.
Retention is very important to allow the aligner to express its mechanics in tooth movement. Use of rectangular attachment can give strong retention and control of tooth movement in multiple planes.

There are several known challenges exist when using clear plastic aligners to treat first premolars extraction cases[15]. The first is preserving posterior anchorage so that the posterior teeth do not move mesially during anterior retraction. The second concern is retracting the canines without tipping the crown distally. Thirdly, maintaining proper incisor inclination along with adequate lingual root torque during anterior retraction. The final concern is to maintain proper final overbite.

To control anchorage of upper arch, keep 18, 28 if they are erupted. Instruct the technician to minimize or no posterior mesialization by closing most of the extraction space by anterior retraction, especially when treating patients with a protrusive profile. If mesialization of the posterior dentition can be minimized, the retraction of the anterior teeth can be maximized. In posterior tooth mesialization, teeth have a higher chance to tip mesially. Molar crown length is also shorter, the mechanics to control root tipping is very difficult. To have better control of posterior mesialisation, move posterior teeth mesial sequentially and leave 1mm space between each tooth during movement.

Consider extraction of the second premolars if the amount of posterior mesialization is significant, or if the second premolar is mesially tilted and shows a higher tendency to tip further during mesialization.

Posterior anchorage can also be aided by good elastic wear. Shifting the balance of forces to the anterior segment minimizes mesial tipping of the upper molars, which avoid unwanted "bowing effects" on the occlusal plane and the development of a posterior opening bite. Timely relief of tight contact of crowded teeth with abrasive strips to aid in tooth movement, may have helped to obtain a more favorable initial treatment outcome and reduce the anchorage demand.

Staged movement of the teeth allows for a better aligner fit by ensuring predictable movement and alignment of teeth[9]. Retract anterior teeth sequentially by retracting 13, 23 first and leave 1mm of space mesial to improve the griping by aligner. The greater the distance the anterior teeth have to travel distally, the greater the risk of unwanted distal crown tip in the canines. The teeth distal to the extraction space area also at a risk of unwanted mesial tip during anterior retraction, as a result of the reciprocal force generated on the posterior teeth during space closure.

To control root tipping during closure of extraction space, canine and posterior teeth need to be moved bodily. Use gable bend movement by moving the roots of the teeth adjacent to the extraction space for 3 to 10 degrees and move teeth bodily.

At the same time, use smaller pontic which leave 1mm of space mesial and distal to it to gain better grip of the adjacent teeth also help.

To avoid retroclination of incisors and deep bite during retraction, addition of extra palatal root torque for 5 to 10 degrees from 12 to 22, then retract them bodily. In clinical situation, a tooth tends to tip more than that planned in clincheck if it is allowed to start tipping in the early stage of treatment. Therefore, we need to instruct initial bodily movement of the tooth. Any tipping movement required to correct incisors proclination should start at a later stage. An overcorrection by instructing compensatory root movement in the direction of translation, or adding lingual root torque in retraction before moving the tooth bodily, may further improve the control of tip and torque in closing an extraction space and during

anterior retraction. The compensatory additions will help to prevent over-retraction of the incisors and deepening of the overbite. Furthermore, to prevent deepening of the overbite during retraction of the incisors, the final overbite was set at 0.5mm as a form of overtreatment.

Case Presentations

All these cases are using clear aligner therapy as they all have a strong desire not to have fixed appliances. Same treatment protocol as described was used in these cases. Maximum anchorage was instructed for the molars and premolars without mesialization, retraction of the canines first before en masse retraction of the anterior teeth. Gable bend movement for the teeth adjacent to extraction space. Compensatory extra root lingual root torque for anterior teeth and set the final overbite edge to edge or just out of contact.

A good improvement in the facial profile was achieved after retraction of upper and lower anterior teeth. The arches were well aligned, with positive overjet and improved overbite. The post treatment panoramic radiograph confirmed bodily movement, with roots completely parallel.

Case 1

The first case is a 21-year-old female presented with the chief complaints of irregular front teeth and an inability to bite in the front because of the open bite. Patient just recovered from leukemia and required approval from her physician to receive orthodontic treatment. Because the patient did not want to wear visible appliances, treatment was planned with the Invisalign system. She had Angle Class I malocclusion with bimaxillary protrusion on a skeletal Class I base complicated by crowding and open-bite. Invisalign orthodontic treatment with extraction of 4 first bicuspids were adopted. The total treatment took 25 months.

Table 1. Key cephalometric values of Case 1

Measurement	Pretreatment	Post treatment	Norms
SNA	80°	81°	83° +/- 4
SNB	72°	71°	80°+/- 3
U1-NA	12°	4°	21°+/- 6
L1-NB	43°	19°	28°+/- 6
Interincisal angle	114°	154°	127°+/- 9
Nasolabial angle	105°	107°	102°+/- 8

Pre-treatment

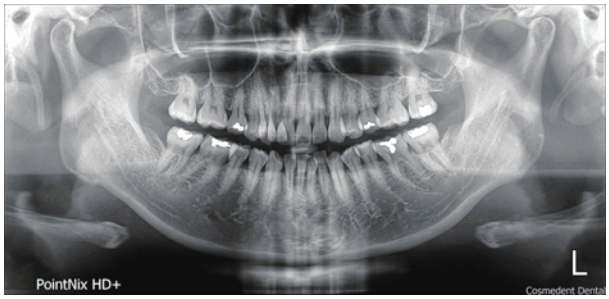

Fig. 1. Pre-treatment panorama.

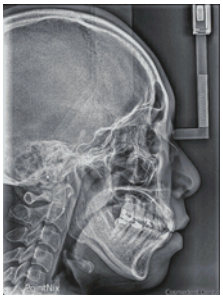

Fig. 2. Pre-treatment cephalometric image.

Fig. 3a-c. Pre-treatment extraoral clinical views.

Fig. 4a-e. Pre-treatment intraoral clinical views.

Clincheck

Fig. 5. Pre-treatment simulation intraoral.

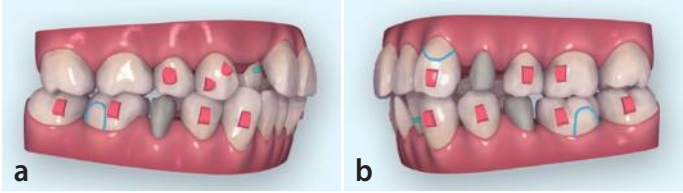

Fig. 6a-b. Simulation treatment plans.

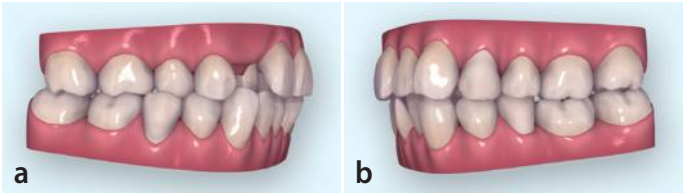

Fig. 7a-b. Simulation treatment results.

Post-treatment

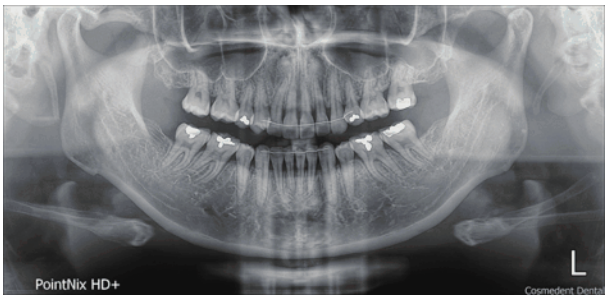

Fig. 8. Post-treatment panorama.

Fig. 9. Post-treatment cephalometric image.

Fig. 10a-c. Post-treatment extraoral clinical views.

Fig. 11a-e. Post-treatment intraoral clinical views.

Case 2

The second case was a 36-year-old female expressed a desire to correct her maxillary anterior crowding with midline shift and improve the esthetic appearance of her smile. The patient profile was convex with both lips slightly protrusive to the E-line. Intraoral examination showed an Angle Class II malocclusion with upper and lower anterior crowding on a skeletal Class II base. Invisalign orthodontic treatment with extraction of 13 due to poor condition of the periodontal tissue, and 3 first bicuspids. The total treatment took 16 months. Mesialization of lower molars is needed for the Class II correction. There is some mesial tipping after space closure. Buttons were bonded to the premolars and molars and intermaxillary elastic was needed to correct the mesial tipping and to improve intercuspation. Post treatment panoramic radiograph showed lower molar tipping but is acceptable intraorally. With the correction of crowding and upper midline shift, patient is very happy with the pleasant smile. The lips were positioned appropriately in relation to the E-line. Angle Class I molar relationship with symmetrical arches was achieved and all spaces were closed. The dental midline coincides with the facial midline.

Table 2. Key cephalometric values of Case 2

Measurement	Pretreatment	Post treatment	Norms
SNA	85°	85°	83° +/- 4
SNB	81.5°	82°	80°+/- 3
U1-NA	41°	18°	21°+/- 6
L1-NB	37°	23.5°	28°+/- 6
Interincisal angle	100°	136°	127°+/- 9
Nasolabial angle	90°	100°	102°+/- 8

Pre-treatment

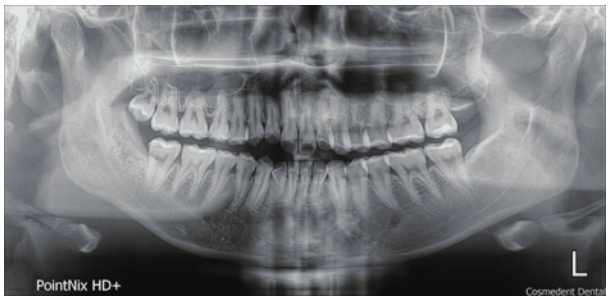

Fig. 12. Pre-treatment panorama.

Fig. 13. Pre-treatment cephalometric image.

Fig. 14a-c. Pre-treatment extraoral clinical views.

Fig. 15a-e. Pre-treatment intraoral clinical views.

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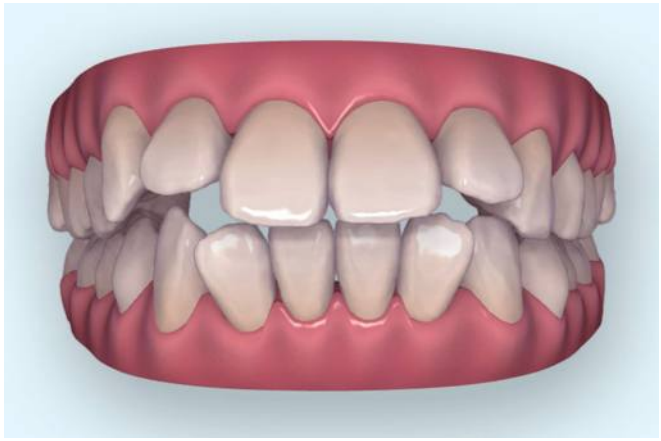

Fig. 16. Pre-treatment simulation intraoral.

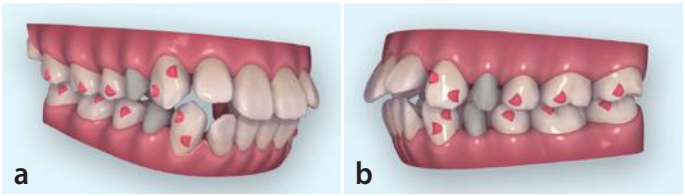

Fig. 17a-b. Simulation treatment plans.

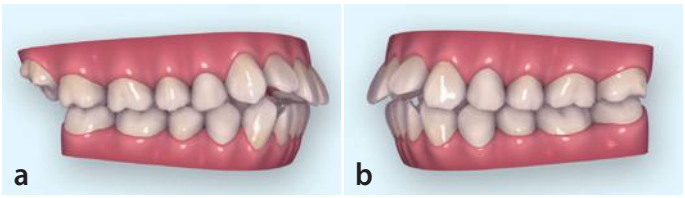

Fig. 18a-b. Simulation treatment results.

Post-treatment

Fig. 19. Post-treatment panorama.

Fig. 20. Post-treatment cephalometric image.

Fig. 21a-c. Post-treatment extraoral clinical views.

Fig. 22a-e. Post-treatment intraoral clinical views.

Case 3

The third case was a 20-year-old female presented with the chief complaints of irregular front teeth and inability to chew well in the front because of the lower teeth were ahead of the upper teeth. Clinical examination showed an Angle class III incisors and molars relationship on a Class III skeletal base complicated by upper crowding, anterior crossbite and protrusive profile. Patient did not want anyone know she is having orthodontic treatment, invisalign orthodontic treatment with 4 first bicuspids extraction was adopted. The total treatment took 36 months. A good improvement in the protrusive profile was achieved after retraction of upper and lower incisors as a result of this non-surgical camouflage treatment. Patient enjoyed having this beautiful smile in front of her friends. Post treatment records showed well aligned arches with a correct incisor relationship, Angle Class I molar relationship, positive overjet and improved overbite. The panoramic radiograph indicated bodily movement rather than simple tipping movements with parallel roots adjacent to the extraction site.

Table 3. Key cephalometric values of Case 3

Measurement	Pretreatment	Post treatment	Norms
SNA	81.5°	82.5°	83° +/- 4
SNB	83°	82.5°	80°+/- 3
U1-NA	35°	19.5°	21°+/- 6
L1-NB	27°	15°	28°+/- 6
Interincisal angle	119°	145°	127°+/- 9
Nasolabial angle	68°	85°	102°+/- 8

Pre-treatment

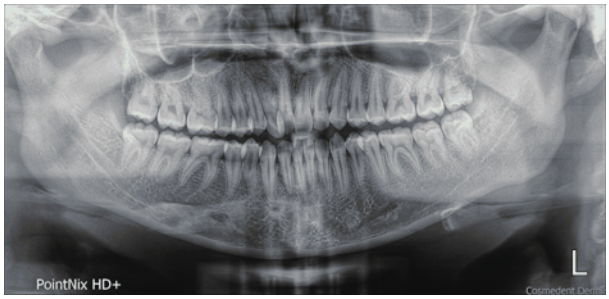

Fig. 23. Pre-treatment panorama.

Fig. 24. Pre-treatment cephalometric image.

Fig. 25a-c. Pre-treatment extraoral clinical views.

Fig. 26a-e. Pre-treatment intraoral clinical views.

Clincheck

Fig. 27. Pre-treatment simulation intraoral.

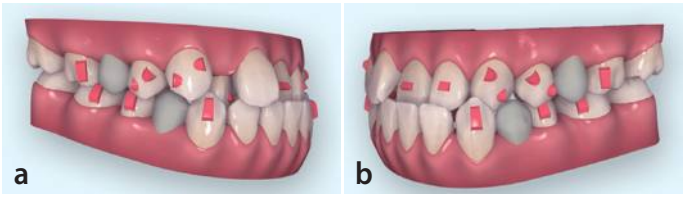

Fig. 28a-b. Simulation treatment plans.

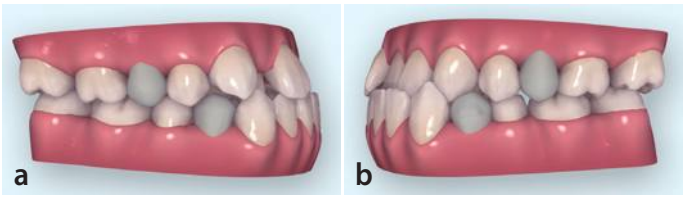

Fig. 29a-b. Simulation treatment results.

Post-treatment

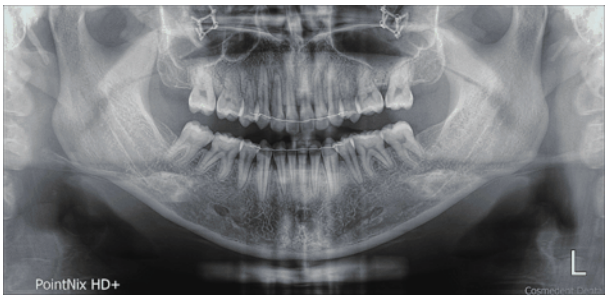

Fig. 30. Post-treatment panorama.

Fig. 31. Post-treatment cephalometric image.

Fig. 32a-c. Post-treatment extraoral clinical views.

Fig. 33a-e. Post-treatment intraoral clinical views.

Discussion

There are few factors in combination to ensure successful clear aligner therapy. Firstly, clinician's technique in treatment design, execution of the planned treatment and good management of patient. Secondly, it will be the expression of the aligner affected by the material used and the design of attachments. Finally, it is the patient compliance which might be the most important contribution to the treatment success.

For premolar extraction cases, it is essential to apply the basic orthodontic principles of maintaining proper incisor torque and root inclinations, controlling anchorage during space closure, and finished with a cusp-to-fossa relationship. Clear aligner treatment has developed from a technique of only treating mild crowding or spacing of anterior teeth to a technique that can be used to treat almost any type of orthodontic problem. We need to understand the limitations of the clear aligner appliance and to be able to think out of the box in treatment planning.

Aligner materials and techniques will continue to improve which will allow aligners to fit better and result in better outcomes. Research into tooth movement mechanics with aligners and the variation in these movements will allow further development of computer algorithms that are used in sequencing aligner tooth movement.

Patient compliance is a critical factor for success with clear aligner treatment. Clear aligner is a removable appliance. Treatment success depends almost completely on how compliant the patient is with wearing aligners for approximately twenty hours a day, seven days a week. Treatment time and ability to complete treatment vary considerably according to the degree of patient compliance20. Before we carry out clear aligner therapy to our patient, we need to make sure the patient is willing to commit to the treatment. Otherwise, it will be zero chance to get the treatment done even if you have a perfect treatment design.

Conclusion

Clear aligner therapy is one of the representative customized orthodontic treatment that worked successfully in past 20 years. As the technology evolves, patient demand and where the clinician is more experienced, more challenging malocclusions may be attempted and treated successfully with clear aligners.

The digital technology around us have pushed us to learn and adapt to new treatment methods in the world of orthodontics. Digital workflows are now increasingly possible in orthodontic practice. Workflows designed to improve the customization of orthodontic appliances are now available through laboratories and orthodontic manufacturing facilities or even orthodontic office in many parts of the world. From digital records, treatment planning, appliance design and manufacture, digital monitoring of treatment. The era of computer aided orthodontic treatment has finally arrived.

Even millions of patients have been treated, very limited in publication through refereed journals, studies have shown clear aligner therapy to be a reasonable strategy for correction of complex malocclusions. Clear aligner therapy is not an evidence -based orthodontic treatment indeed, much of the literature consists of case reports. It does deserve more clinical research (RCT) to be done to further improve and progress the clear aligner technique. However, this do not prevent it to be a main stream treatment option in contemporary orthodontics. New technology will not replace clinicians. However, Clinicians who use new technology will replace those don't.

Welcome to a whole new world of digital customized orthodontics.

References

1. Boyd RL, Miller RJ, Vlaskalic V. The Invisalign system in adult orthodontics: mild crowding and space closure cases. J Clin Orthod.2000;34(4):203-212.

2. Kesling HD. The philosophy of the tooth positioning appliance. Am J Orthod. 1945; 31(6): 297-304.

3. Kuo E, Miller RJ. Automated custom-manufacturing technology in orthodontics. Am J Orthod Dentofacial Orthop. 2005; 123 (5): 578-581.

4. Zheng M, Liu R, Ni Z, Yu Z. Efficiency, effectiveness and treatment stability of clear aligners: a systematic review and meta-analysis. Orthod Craniofac Res. 2017; 20:127-133.

5. Drake CT, McGorray SP, Dolce C, Nair M, Wheeler TT. Orthodontic tooth movement with clear aligners. ISRN Dent 2012:657973.

6. Rossini G, Parrini S, Castroflorio T, Deregibus A, Debernardi CL. Efficacy of clear aligners in controlling orthodontic tooth movement: A systematic review. Angle Orthod 2015; 85: 881-9.

7. Rossini G, Parrini S, Deregibus A, Castroflorio T. Controlling orthodontic tooth movement with clear aligners: An update systemic review regarding efficacy and efficiency. J Align Orthod 2017; 1: 3-4.

8. Lagravere MO, Flores-Mir C. The treatment effects of Invisalign orthodontic aligners: a systematic review. J Am Dent Assoc. 2005; 136:1724-1729.

9. Simon M, Keilig L, Schwarze J, Jung BA, Bourauel C. Treatment outcome and efficacy of an aligner technique-regarding incisor torque, premolar derotation and molar distalization. BMC Oral Health. 2014; 14: 68.

10. Houle JP, Piedade L, Todescan Jr R, Pinheiro F. The predictability of transverse change with Invisalign. Angle Orthod. 2017; 87: 19 - 24.

11. Grunheid T, Loh Charlene, Larson B. How accurate is Invisalign in nonextraction cases? Are predicted tooth positions achieved. Angle Orthod. 2017; 87: 809 - 815.

12. Honn M, Goz G. A premolar extraction case using the Invisalign system. J Orofac Orthop 2006; 67: 385 - 394.

13. Womack WR. Four-premolar extraction treatment with Invisalign. J Clin Orthod. 2006; 40:493-500.

14. Li W, Wang S, Zhang Y. The effectiveness of the Invisalign appliance in extraction cases using the ABO model grading system: a multicenter randomized controlled trial. Int J Clin Exp Med 2015; 8: 8276-8282.

15. Baldwin DK, King G, Ramsay DS, Huang G, Bollen AM. Activation time and material stiffness of sequential removable orthodontic appliances. Part 3: premolar extraction patients. Am J Orthod Dentofacial Orthop. 2008; 133:837-845.

16. Peck S, Peck H. Frequency of tooth extraction in orthodontic treatment. Am J Orthod 1979; 76: 491 - 496.

17. Xu TM, Liu Y, Yang MZ, Huang W. Comparison of extraction versus non-extraction orthodontic outcomes for borderline Chinese patients. Am J Orthod Dentofacial Orthop 2006; 129:672 - 677.

18. Gierie WV. Clear Aligner Therapy: an overview. JCO 2018; 52: 665

19. Samoto H, Vlaskalic V. A customized staging procedure to improve the predictability of space closure with sequential aligners. JCO 2014; 48: 359 - 367.

20. Al-Moghrabi D, Salazar FC, Pandis N, Fleming PS. Compliance with removable orthodontic appliances and adjuncts: A systematic review and meta-analysis. Am J Orthod Dentofacial Orthop 2017; 152: 17-32.

21. Vlaskalic V, Samoto H. Class II correction with weekly changes of computer-generated aligners: distalize or jump. JCO 2018; 52: 684-700.

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New Horizon of Digital Orthodontic software

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A Planned Approach for Anterior Dental Esthetics

Chankwon Jung, DDS, MSD, PhD

Introduction

Anterior restoration is a dental procedure that can provide a high level of satisfaction to both the dentist and the patient. However, procedures can result in disappointment when esthetic problems arise as a consequence of the treatment.

Techniques used in the current clinical approach to anterior restorations are also applied to implant restorations.

Unlike posterior restorations, anterior restorations require special attention to esthetic outcomes. All dental care involves trade-offs between gains and losses. If a treatment option achieves more gains than losses in the patient's oral cavity, it is considered to be a good treatment. Conversely, if a treatment option results in more losses than gains, it will unlikely be accepted by clinicians.

In anterior restorations, a natural tooth restoration is often performed concurrently with an implant restoration, and good results can be ensured only when both treatments have been satisfactorily performed.

In an esthetic anterior restoration, a **planned treatment approach to restoration procedure** is essential for predictable and reliable clinical and esthetic outcomes, although the results can vary depending the dentist's strategy and the techniques applied.

This article examines the clinical procedure of anterior restorations of natural teeth administered concurrently with implants, covering important clinical considerations necessary for ensuring the esthetics of soft tissue surrounding tooth and implant.

The esthetics of soft tissue has been a topic in many cosmetic dentistry journals, which is a testament to its importance and difficulty. Volume and form optimized for the esthetics of soft tissue have been widely discussed in terms of regain using a variety of highly sophisticated techniques. However, there is a need to reflect on the risk of inadvertent detriment to esthetics by failing to preserve natural volume and shape. The preservation of soft tissue is more dependent on an accurate overview of the clinical procedural sequence rather than the use of sophisticated techniques. We report a clinical case which was performed with this aspect in mind.

Case Presentations

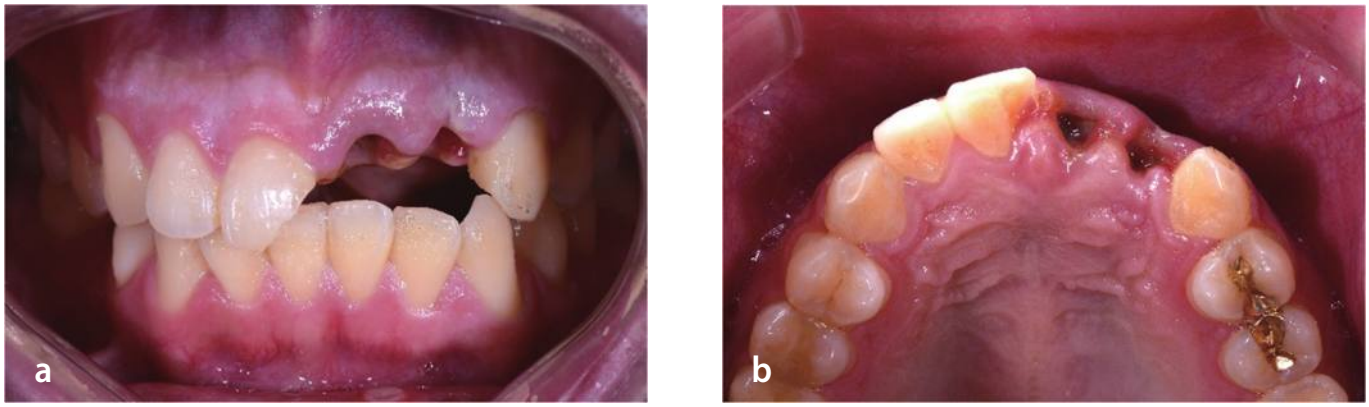

Fig. 1a-b. The patient presented with fractured right maxillary central incisor and missing left maxillary central and lateral incisor due to trauma. If the existing gingival scallop could not be preserved, this case would present a considerable esthetic challenge. However, if the existing gingival scallop remains intact after the treatment, satisfactory esthetics can easily be achieved. This requires attention to the provisional restoration phase following the implant placement.

Chankwon Jung

Dr. Chankwon Jeong was graduated from Yonsei University College of Dentistry, He obtained a Master of Science in Dentistry and a PhD in alma mater. He is a one of best clinician in esthetic dentistry in Korea. He is currently board member of Korean Academy of Esthetic Dentistry. He is a director of ATC study group & Osstem AIC master course. He maintains a private practice in Seoul, Republic of Korea.

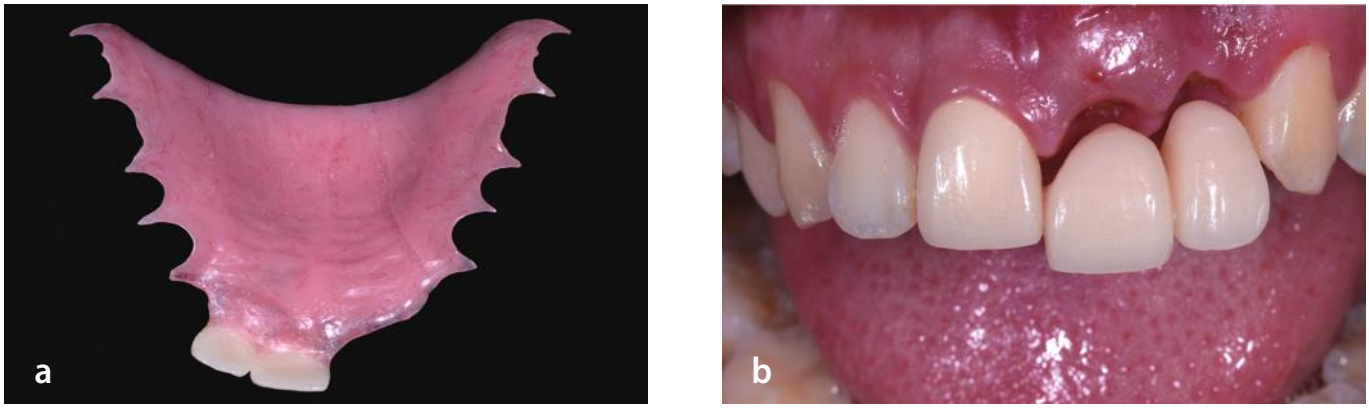

Fig. 2a-b. After endodontic treatment, we fabricated and installed a fixed provisional restoration on the traumatized tooth, and two provisional restorations in the edentulous region to preserve the existing gingival architecture. Two months later, an impression was taken, and fixed provisional restorations were fabricated and installed for both the natural tooth and the implants.

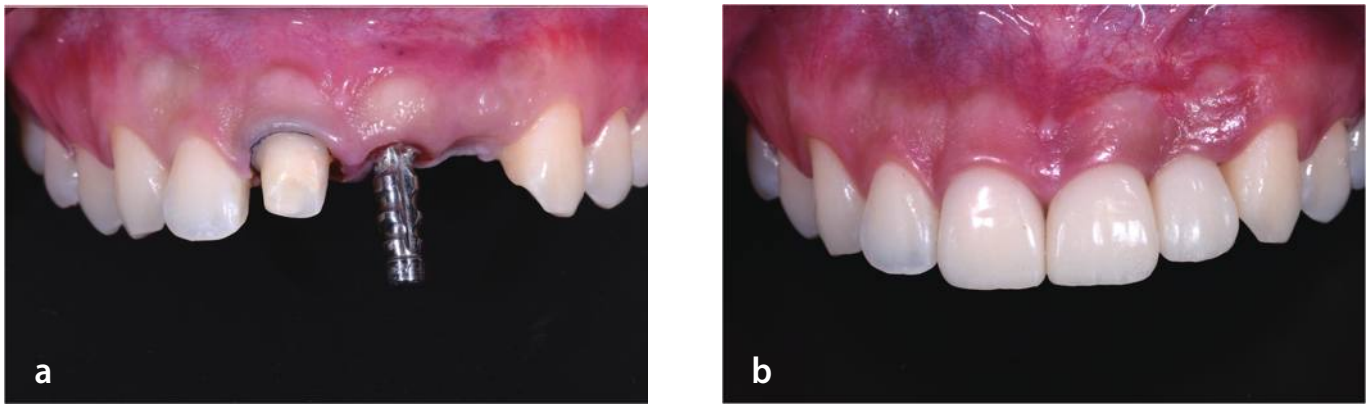

Fig. 3a-b. At this stage, particular attention should be paid to the peri-restoration soft tissue management to prevent gingival recession. This is mostly achieved through proper contouring of the provisional restorations.

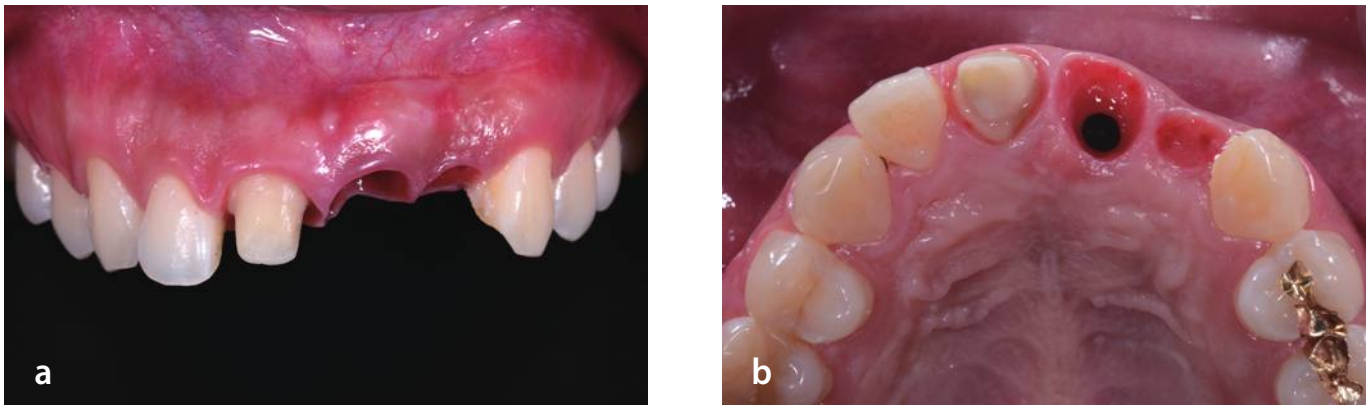

Fig. 4a-b. No gingival recession occurred as a result of the above procedure, which is a prerequisite for fabricating the final restorations without compromising esthetics. I have removed the term "sufficient condition" since I feel it was redundant in this sentence.

Fig. 5a-c. After taking the final impression, we fabricated a zirconia restoration for the natural tooth, and screw-type and pontic form implants for #21 and #22 respectively.

Fig. 6a-c. These clinical photos show the oral situation immediately after the removal of excess cement and the first follow-up at 2 weeks. It was completed without any significant esthetic consequences. There are some shortcomings, such as insufficient volume of soft tissue in the #22 region. To improve peri-implant soft tissue, an additional procedure such as CTG technique should have been used.

Conclusion

As a rule of thumb, preservation leads to more efficient and stable outcomes compared to regain in anterior dental esthetics, for both natural teeth and implants.

The main difficulty with anterior implant restorations is esthetic failure. In most cases, this is a consequence of loss of peri-implant soft tissue.

Many efforts are put into achieving satisfactory esthetic results of anterior implants. However, overemphasis on technique during the entire treatment procedure often cause mistakes in the clinical approach. This leads to great esthetic losses.

Cases of esthetics-related difficulties are familiar to all involved. However, such difficulties can easily be overcome to achieve satisfactory esthetics. This requires a coherent clinical approach, and an accurate overview of procedural sequence of the case.

In this article, we discussed a clinical approach to the planned restoration of traumatized teeth. We hope that it will be of help to young clinicians who experience difficulties with anterior implant restoration due to lack of experience.

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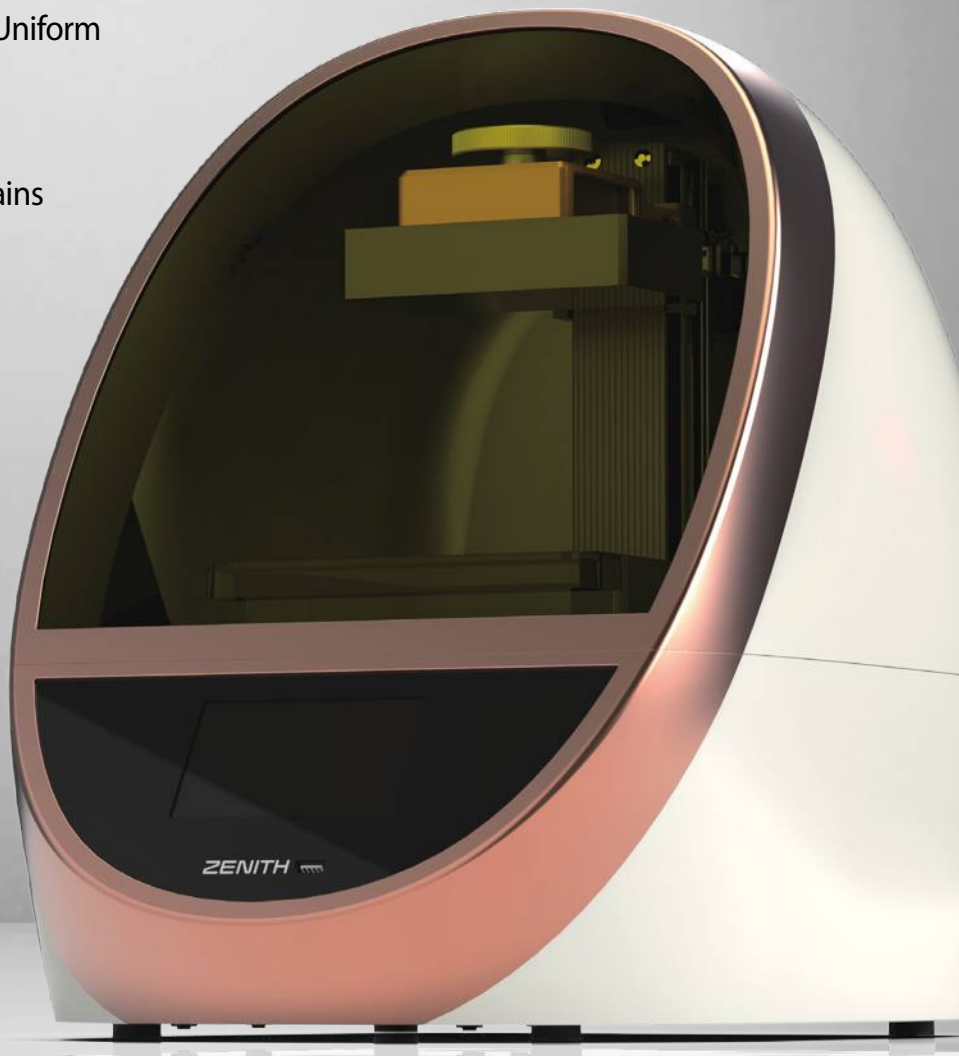

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Anterior Gingivectomy Using a 3D-Printed Surgical Guide Based on Digital Smile Design: a Case Report

Jiman Park, DDS, MSD, PhD

Introduction

Integration of various digital technologies into dental practice has substantially simplified conventional dental procedures requiring complicated techniques and methods[1]. Integrative dental treatment combining CAD software (e.g., Digital Smile Design and Implant Studio) and intraoral scan data allows the dentist to discuss the case with the patient based on intuitive and accurate image data at the diagnostic and treatment planning stages. This makes it possible to set up a digital dental clinic where all dental procedures (from the initial diagnosis to the final restoration) can be done in a seamless CAD/CAM workflow. Furthermore, continuous development of CAM equipment and 3D printers and their growing applications in dental clinics have led to more reasonable pricing and user-friendly operation, greatly contributing to fabricating restorations more efficiently and accurately and thus enabling customized care tailored to individual needs and preferences instead of uniform treatment.

There are three major areas of 3D printing technology: consumer goods, industrial production, and medical/dental care, accounting for 22%, 19%, and 17%, respectively, of 3D printing applications. In the consumer goods field, which is characterized by small quantity and item diversity, 3D printers are used for producing foods (e.g., anthropomorphic jelly beans), toys (e.g., cartoon character figures), jewelry items (e.g., rings and pendants), and the like. In key industrial fields, 3D printing is used for time- and cost-saving production workflows such as automotive body structure, titanium parts for fighter aircrafts, and machine parts requiring high accuracy and precision. In the medical field aiming at customized patient care, 3D-printed surgical guides are employed in orthopedics, dentistry, cosmetic surgery, and the like for the purpose of determining the location of the osseous cut or implant placement[2], 3D-printed orthopedic implants are used as surgical artificial organs or organ substitutes in reconstructive surgery on cranial tegmentum, oral-maxillofacial bone replacement graft, spine surgery, hip surgery, etc[3]. and 3D bioprinting for artificial cell culture, such as hepatocytes, myocardial cells, and vascular cells, to fabricate artificial tissues/organs ready for implantation.

Dentistry is one of the earliest application areas of 3D, printing primarily in the domain of oral and maxillofacial surgery, with preoperative prototype fabrication or surgical simulation enabled by a rapid prototype (RP) model using 3D-printed CT data output. However, it is through 3D-printed implant surgical guides that the dental application of 3D printing started to gain traction. When 3D-printed implant surgical guides such as NobelGuide began to be marketed in mid-2000, their application was limited because of high production costs. With increasing applications in dental practice, however, all Korean implant companies have been producing and supplying dental implant surgical guides, and they are now widely used in dental clinics[2], The use of intraoral scanners has also been growing, and domestic intraoral scanners for clinical use are supplied at prices affordable to dental clinics[1], A 3D printer is indispensable for developing a tangible model from an intraoral digital impression obtained by an intraoral scanner. Furthermore, with the development of methods enabling immediate post-extraction placement of 3D-printed provisional restorations from a digital impression while the final restorations are being made by an outside lab, the use of 3D printers in dental clinics is expected to grow even more.

Whereas intraoral scan data, profile photos, and facial scan data are all useful as standalone information, their usefulness is greatly multiplied when arranged together on one single plane in an

Jiman Park

Prof. Jiman Park, has Graduated from Seoul National University in 2002. He trained at the department of prosthodontics, Seoul National University Dental Hospital. He gained Ph. D and Master's degree at Seoul National University. He started working as an assistant professor at Ewha Womans University in 2009 and did his best on dental treatment, research and education until 2015. He was a clinical associate professor at Seoul National University Gwanak Dental Hospital from 2015 to 2017. He has been a clinical associate professor at Yonsei University, College of Dentistry since 2017. He has studied on the digital dentistry and the clinical application of intraoral scanner and 3D printer. He also has worked on the government research projects, "Standardization of evaluation protocol for the performance comparison of digital intraoral scanners", and "Development of 3D printable polymer and ceramic material and associated printer"
Jiman Park is an active member of IADDM (International Academy of Digital Dental Medicine), IADR, AO, AAP, and works as an editing executive director at KAOMI (Korean Academy of Oral & Maxillofacial Implantology)

integrated manner. 4 In aesthetic restoration cases, for example, the integrative use of these image data facilitates the measurement of the interpapillary distance and degree of upper lip eversion necessary for determining the horizontal plane and length of the anterior maxilla.

When used in combination with 3D facial scanning, previously unknown information, such as the degree of protrusion of the CAD-designed tooth profile, is made available in dental aesthetics. The related clinical cases involve 2D image and intraoral scan data alignment and combination of 3D facial and intraoral scan data. The former is easy to use because it does not require a separate facial scanner, but it can be applied only to frontal view, whereas the latter requires various equipment and tools, but enables 3D analysis. In recent years, various software programs based on the former method have been developed and are beginning to find clinical applications. Typical examples are software applications using the Digital Smile Design (DSD).

Along-side general-purpose programs such as Photoshop and Keynote, there are a number of solutions including DSD App, Smile Designer Pro, Aesthetic Digital Smile Design, 3Shape Smile Design, CEREC Software 4.2, and VisagiSmile. Application examples of these programs are retrieval of ideally shaped incisors from the library to overlay them on the patient's current teeth, preliminary diagnosis for scheduled consultation, treatment planning with the patient with enhanced prognostic accuracy. 5-7 Upon completion of digital diagnosis and treatment planning, the final model for aesthetic restorations, provisional restorations, and a teeth removal guide can be prepared for clinical use. 8 In cases where gingivectomy is necessary, a surgical guide can be prepared based on DSD. This case report presents a case of DSD application in preparing a gingivectomy guideline and its implementation using 3D printing.

Case Presentations

Digital Smile Design (DSD) Process

A 20-year-old woman presented with the complaint of excessive gingival display when smiling, the so-called "gummy smile". In an aesthetic diagnosis, it was found that restoration should involve gingivectomy because of inadequate aspect ratio of the teeth and excess gum tissue. For the use of DSD in the aesthetic diagnosis, profile pictures were taken with a natural smile and with the lips excluded with a cheek retractor **(Figs. 1 and 2)**.

A digital impression was also taken using an intraoral scanner (i500, Medit Corp.).

In this case, aesthetic diagnosis was performed using 3Shape Smile Design Software. The smile design process was divided into two steps: setting up a 2D smile design on the profile photo with a smile and aligning it with the intraoral scan data, followed by a conversion to a 3D CAD design. In the process of 2D smile design, the ideal tooth position and shape were configured on the natural-smile profile photo using the smile selected from among various smile models in the smile library presented by sex and age **(Fig. 3)**. It was checked whether the intraoral shape matches well with the overall facial appearance using a cheek retractor, and fine adjustments were made to each tooth to match its shape and dimensions to the optimal tooth width and width/length ratio **(Fig. 4)**. The 2D result obtained from the profile photo were converted into a 3D image after superposing it with the intraoral scanner. RealView Engine facilitated the 3D?2D alignment **(Fig. 5)**. After the data alignment, the anatomical design for each tooth was shown on the CAD interface, and the CAD tools (multi-tooth, single-tooth, and smart tools) converted the 2D smile design into a 3D smile design **(Fig. 6)**.

Fig. 1. Profile photo for Digital Smile Design (DSD).

Fig. 2. Initial diagnostic dental photo. The patient's chief complaints were excessive gingival display and short tooth length when smiling.

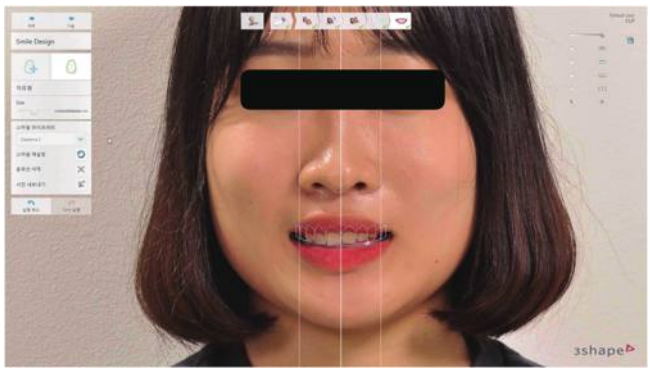

Fig. 3. Smile design process using 3Shape Smile Design software. The ideal tooth position and shape are configured on the natural-smile profile photo. With the patient, the dentist can select the best match from among a total 18 smile models presented in the smile library by sex and age.

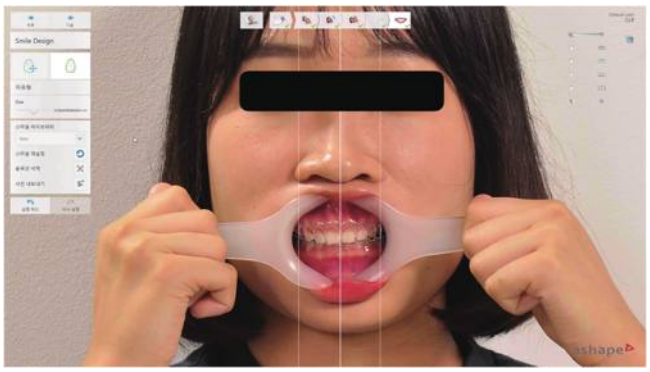

Fig. 4. On the image of the teeth fully exposed by a cheek retractor, it can be rechecked if the smile selected in the library matches well with the overall facial appearance. Then fine adjustments are made to each tooth to match its shape and dimensions to the optimal tooth width and width/length ratio.

Fig. 5. Intraoral scan data are aligned over the custom designed 2D smile frame and converted into 3D data. 3D-2D alignment can be easily implemented using 3Shape's RealView Engine. Fine adjustments are then made using the adjustment knob, which rotates the intraoral scan data on a 3D plane.

Fig. 6. Upon completion of the alignment of the intraoral scan data, the anatomical design of each tooth appears via the CAD function inherent to the Dental System, and the CAD tools (multi-tooth, single-tooth, and smart tools) convert the 2D smile design into a 3D smile design.

Design of the Gingivectomy Guide

Upon completion of the 3D smile design, a gingivectomy guide was designed using the 3Shape Dental System. Scan data, especially intraoral scanner data, are complicated because of the moving tissues scanned together, which makes the data processing error-prone and time-consuming. In the current case, margin trimming was performed to address this problem **(Fig. 7)**. After the path of apparatus insertion and removal was configured, the block-out tool was used to trim the undercut area **(Fig. 8)**, followed by setting the apparatus area and shaping the tray to be used for the execution of the gingivectomy guide **(Fig. 9)**. Using the "Base Thickness" and "Tooth Gap" features, an adequate thickness was given to the apparatus to be 3D-printed, and a well-fitting tray was designed by performing fine adjustments to the thickness of the tray and the extent of the portion to be buried into it **(Fig. 10)**.

The blue 3D smile design was checked against the gingival architecture configured at the initial diagnostic consultation, with the transparency adjusted by moving the horizontal knob in the upper right-hand corner. The shape of the holes to serve as the guide during the gingivectomy was configured on the tray. The upper margin of the window was configured along the gingival margin as marked in the blue 3D smile design, and the lower margin was configured with some extra space for the scalpel to be easily pulled out along the lower path **(Fig. 11)**. The design of the gingivectomy guide was completed with the configuration of the outer margins and window areas. Through the window, the gingival contour configured at the initial diagnostic consultation, which passes through the center, and the upper gingival margin determined by the 3D smile design could be confirmed **(Figs. 12 and 13)**.

Dentistry is one of the earliest application areas of 3D printing, primarily in the domain of oral and maxillofacial surgery, with preoperative prototype fabrication or surgical simulation enabled by a rapid prototype (RP) model using 3D-printed CT data output. However, it is through 3D-printed implant surgical guides that the dental application of 3D printing started to gain traction. When 3D-printed implant surgical guides such as NobelGuide began to be marketed in mid-2000, their application was limited because of high production costs. With increasing applications in dental practice, however, all Korean implant companies have been producing and supplying.

Dental implant surgical guides, and they are now widely used in dental clinics. 2 The use of intraoral scanners has also been growing, and domestic intraoral scanners for clinical use are supplied at prices affordable to dental clinics. 1 A 3D printer is indispensable for developing a tangible model from an intraoral digital impression obtained by an intraoral scanner. Furthermore, with the development of methods enabling immediate post-extraction placement of 3D-printed provisional restorations from a digital impression while the final restorations are being made by an outside lab, the use of 3D printers in dental clinics is expected to grow even more.

Fig. 7. A gingivectomy guide was designed based on the 3D smile design. Data pruning was performed by cutting out a broader margin than the area to be covered by the intraoral scan data to enhance processing efficiency. The apparatus margins were marked on the image data.

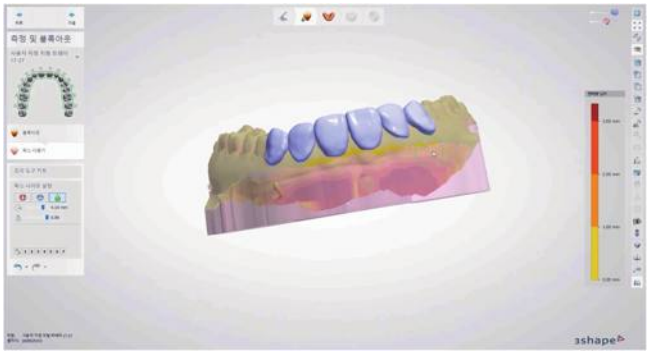

Fig. 8. Once the path of apparatus insertion and removal is configured, the range and extent of the undercut area to which the prosthesis can be applied. The protruded parts of the undercut can be trimmed with the block-out tool.

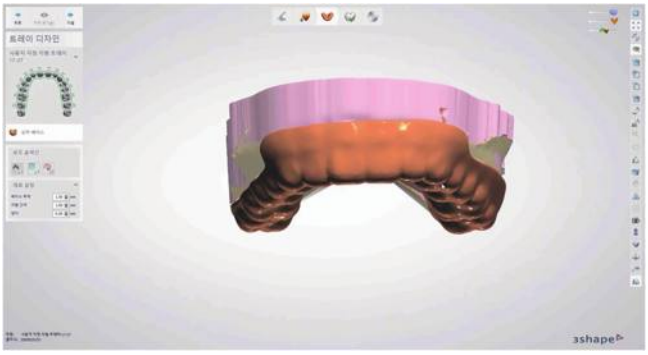

Fig. 9. The tray shape is determined by a computation based on the area and relief configured, and the tray is punctured along the gingival contour to be cut away.

Fig. 10. Base thickness and tooth gap are set and to give an adequate thickness of the apparatus to be 3D-printed, and find adjustments were made to the thickness of the tray and extent of the portion to be buried into it. The apparatus architecture can be checked by increasing the transparency with the horizontal adjustment knob placed in the upper right-hand corner.

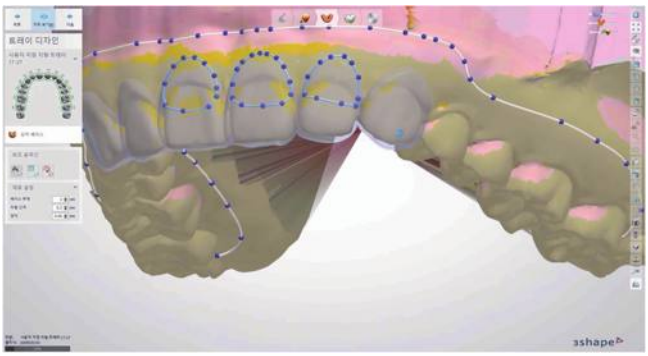

Fig. 11. The areas for drilling holes on the tray were marked while checking the shape against the gingival architecture configured at the initial diagnostic consultation by lowering the transparency of the blue-highlighted 3D smile design. The upper margin of the window was configured along the gingival margin as marked in the blue 3D smile design, and the lower margin was configured with some extra space for the scalpel to be easily pulled out along the lower path.

Fig. 12. Completion of the outer margin and window area configurations of the gingivectomy guide.

Fig. 13. The completed design of gingivectomy guide. Through the window, the gingival contour configured at the initial diagnostic consultation, which passes through the center, and the upper gingival margin determined by the 3D smile design can be confirmed.

Design of the Alveolectomy Guide

Additionally, an alveolectomy guide was designed because alveolectomy was indicated due to a large amount of gum tissue to be removed in gingivectomy **(Fig. 14)**. A biological width should be provided for the alveolar bone to the depth of 3mm from the designed gingivectomy line, which requires a crescent-shaped window. Since 3Shape Dental System does not provide features for shaping this type of window, the alveolectomy guide was designed with the general-purpose CAD tool Rhino (ver. 6, Robert McNeel & Associates).

The parts of the alveolar bone to be removed on the DSD were formed on the prefabricated tray design **(Fig. 15)**. A cylinder with the window area at the bottom was created and placed penetrating through the tray, then Boolean calculation for removing intersection area was performed **(Fig. 16)**. The cylinder was placed perpendicular to the tray's outer surface to ensure the application of the scalpel from an accurate angle, and its position was adjusted by moving it with the trackball feature **(Figs. 17 and 18)**.

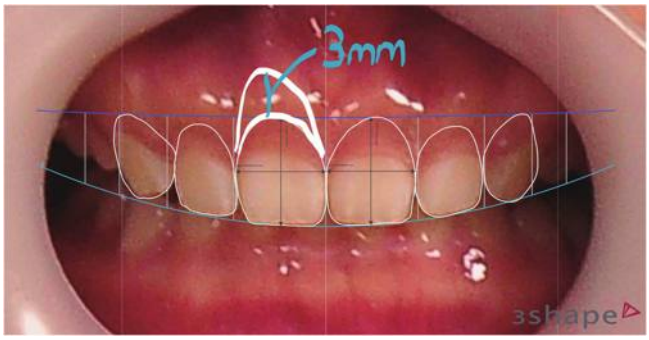

Fig. 14. Configuration of the DSD based alveolectomy guideline taking account of the biologic width of teeth.

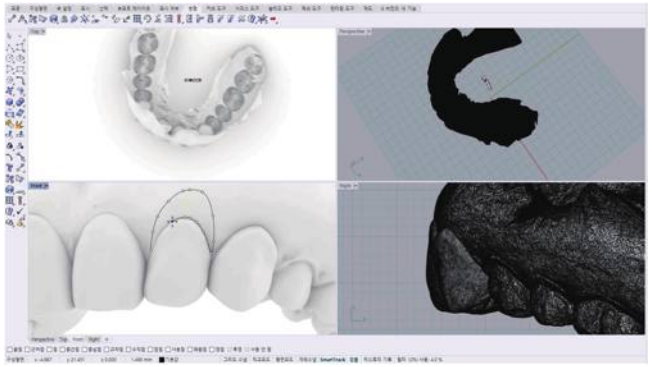

Fig. 15. Configuration of the area for the alveolectomy guideline configured during the diagnostic process to be directly transferred to the window. Since 3Shape Dental System does not provide features to create crescent-shaped window, a general-purpose CAD. tool was used for the design of the alveolectomy guide.

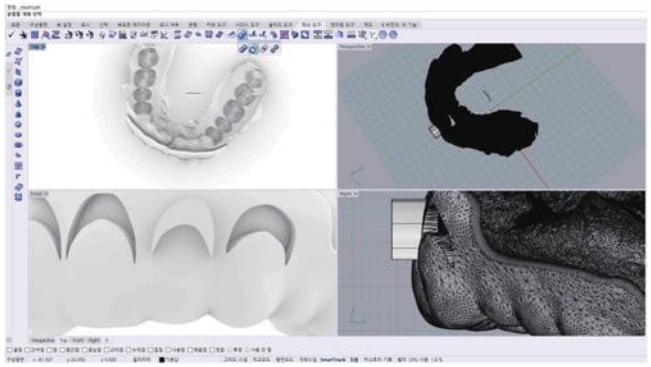

Fig. 16. For the alveolectomy guide design, a cylinder was created with the configured window shape, which was then placed penetrating through the tray, and the design was completed with Boolean calculation for removing intersection area.

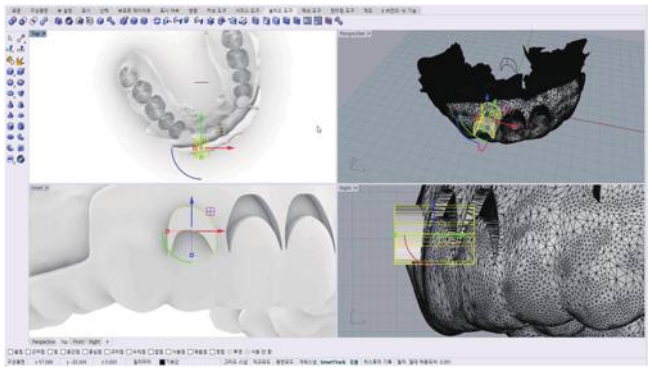

Fig. 17. The cylinder was placed perpendicular to the tray's outer surface and its position was adjusted by moving it with the trackball feature.

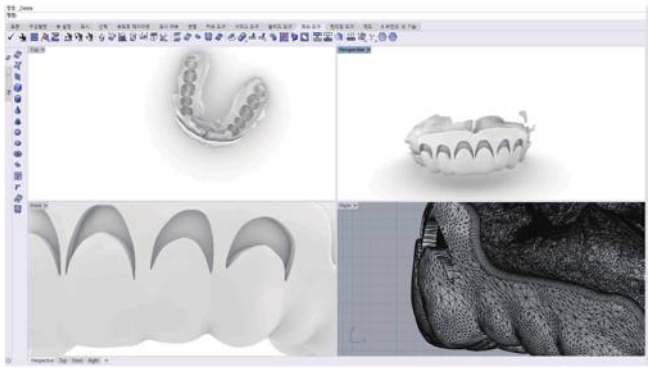

Fig. 18. The completed design of alveolectomy guide.

Gingivectomy

The gingivectomy and alveolectomy guides designed above were fabricated with a dental surgical guide material (SG, NextDent), using a DLP-type 3D printer (D2, Veltz 3D). After the design file extraction in the .stl format, the guides were arranged along the printing direction using the dedicated slicing software. Then the support was connected and sliced 25-um thick. The 3D-printed guides were rinsed with 95% isopropyl alcohol and completely cured so as to leave no residual monomer in the post-curing machine.

They fit well within the oral cavity because block-out was performed in advance in the design process **(Fig. 19)**. Gingivectomy was performed with a scalpel along the inner window margin of the gingivectomy guide for collar tissue removal **(Fig. 20)**. Then alveolectomy was performed after elevating the full-thickness flap. First, the scope of alveolectomy was marked with the scalpel along the upper inner margin of the alveolectomy guide. Then the alveolar bone below the marked line was removed to ensure the biological width and thus maintain the effect of gingivectomy **(Fig. 21)**. Lastly, alveolectomy was completed by smoothing the surface with an end-cutting bur **(Fig. 22)**.

Fig. 19. 3D-printed gingivectomy and alveolectomy guides and their intraoral fitting.

Fig. 20. Clinical application of the gingivectomy guide: gingivectomy is performed along the inner margin of the window to remove collar tissue.

Fig. 21. Clinical application of the alveolectomy guide: After elevating the full-thickness flap and marking the scope of alveolectomy with the scalpel along the upper inner margin of the window, the alveolar bone was removed to ensure the biological width and thus maintain the effect of gingivectomy.

Fig. 22. Post-treatment intraoral and smile photos: Alveolectomy was completed by smoothing the surface with an end-cutting bur.

Discussion

The traditional approach to diagnosis and treatment planning for aesthetic restoration of anterior maxilla involves a diagnostic wax-up on a cast. However, this diagnostic approach is more prone to error compared with diagnosis under direct view of the patient's intra- and extra-oral situations. However, as shown in this case report, when the aesthetic restorative treatment is performed using Digital Smile Design (DSD) software, diagnosis and treatment planning are done on CAD software, and the intraoral situation of the patient can be checked in a 3D space in natural-color representation. At the same time, an overall harmony with the facial appearance can also be considered. All these features contribute to accurate treatment outcome prediction. Intuitive and effective dentist-lab communication and work are carried out because comprehensive 3D information is shared instead of a simple oral communication and 2D image data. The dentist patient communication is also improved substantially because smile design results can be viewed immediately in the clinic and used as the basis for consultation for treatment planning[4-6].

Because we used 2D patient profile photos, no 2D lateral view information such as the extent of labial protrusion was obtained. Although 2D profile photos sufficiently served the purpose of gingivectomy of anterior maxilla, 3D-based diagnosis using 3D facial scans is recommendable in cases involving final restoration fabrication.

As future trends, we expect the emergence of various digital clinical care systems integrating different types of information, such as facial traits obtained with various digital tools, facial scans, profile photos, and CT, different CAD-based applications, and 3D printing/CAM process and their clinical use in organic and efficient linkage.

Conclusion

Digital Smile Design (DSD)-based gingivectomy and alveolectomy can be successfully administered to patients with gummy smile, excessive gingival display when smiling, by directly transferring the DSD established at the treatment consultation stage to the 3D-printed surgical guides. In contrast to conventional surgery based on marking the gingival tissue area to be removed on an empirical basis, whereby the surgical outcome differs depending on the dentist's experience and skills, dental surgery based on digital workflow has more accurate surgical outcome prediction and more reliable reproducibility.

References

1. Kim RJ, Park JM, Shim JS. Accuracy of 9 intraoral scanners for complete-arch image acquisition: A qualitative and quantitative evaluation. J Prosthet Dent 2018 Dec;120(6):895-903.e1.

2. Oh KC, Park JM, Shim JS, Kim JH, Kim JE, Kim JH. Assessment of metal sleeve-free 3D-printed implant surgical guides. Dent Mater 2019 Mar;35(3):468-476.

3. Park JM, Ahn JS, Cha HS, Lee JH. Wear Resistance of 3D Printing Resin Material Opposing Zirconia and Metal Antagonists. Materials (Basel) 2018 Jun 20;11(6).

4. Park JM, Oh KC, Shim JS. Integration of intraoral digital impressions with a 3D facial scan for anterior tooth rehabilitation. J Prosthet Dent 2018 Oct 31. [Epub ahead of print]

5. Veneziani M. Ceramic laminate veneers: clinical procedures with a multidisciplinary approach. Int J Esthet Dent. 2017;12(4):426-448.

6. Rojas-Vizcaya F. Prosthetically guided bone sculpturing for a maxillary complete-arch implant-supported monolithic zirconia fixed prosthesis based on a digital smile design: A clinical report. J Prosthet Dent 2017 Nov;118(5):575-580.

7. Park JM, Kim JY, Shim JS. Review of Computer-assisted Implant Surgeries: Navigation Surgery System vs. Computer-guided Implant Template vs. Robot. Implantology 2018 Jan;22(1):56-65.

8. Liu X, Yu J, Zhou J, Tan J. A digitally guided dual technique for both gingival and bone resection during crown lengthening surgery. J Prosthet Dent 2018 Mar;119(3):345-349.

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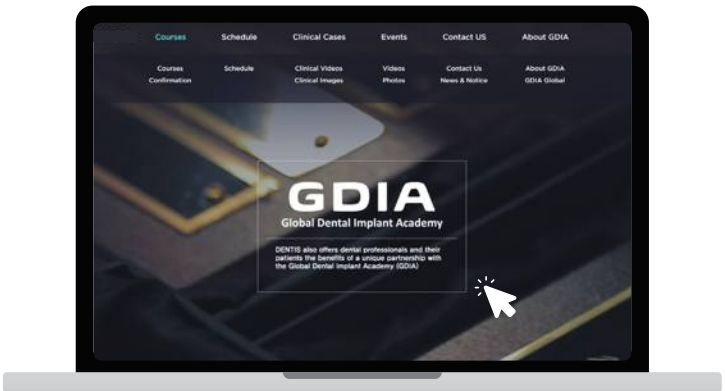
Second half of 2019

DENTIS Seminar & Symposium Schedule

DATE		EVENT		DIRECTOR	VENUE
Jun.	15	Symposium	SQ Launching Seminar in SEOUL		Suwon (Korea)
	22	Seminar	Proper use of 3D printer, ZENITH	Sichan Park/Taegu Chung	Suwon (Korea)
	15/16/29/30	Seminar	[DENTIS X DENTAL BEAN] Black Course - Strategies for maxillary sinus elevation and treatment of maxillary molar region	Insung Jeon/Sewoung kim	Seoul (Korea)
Jul.	6/7	Seminar	[DENTIS X DENTAL BEAN] Black Course - Strategies for maxillary sinus elevation and treatment of maxillary molar region	Insung Jeon/Sewoung kim	Seoul (Korea)
	13/14	Seminar	ALL+COMPLICATION	Insung Jeon	Seoul (Korea)
	13/14/27/28	Seminar	[DENTIS X DENTAL BEAN] Red Course - Start of Implant surgery and prosthetics	Yongseok Cho/Sewoung kim	Seoul (Korea)
Aug.	10/11/24/25	Seminar	[DENTIS X DENTAL BEAN] Red Course - Start of Implant surgery and prosthetics	Yongseok Cho/Sewoung kim	Seoul (Korea)
Sep.	21/22	Seminar	[DENTIS X DENTAL BEAN] Blue Course - Soft tissue grafting and full mouth for esthetics of maxillary anterior teeth	Insung Jeon/Sewoung kim	Seoul (Korea)
	29	Symposium	DENTIS WORLD SYMPOSIUM in SEOUL		Seoul (Korea)
Oct.	5/6/19/20	Seminar	[DENTIS X DENTAL BEAN] Blue Course - Soft tissue grafting and full mouth for esthetics of maxillary anterior teeth	Insung Jeon/Sewoung kim	Seoul (Korea)
	12/13	Seminar	[DENTIS X DENTAL BEAN] Red Course - Start of Implant surgery and prosthetics	Yongseok Cho/Sewoung kim	Seoul (Korea)
Nov.	3	Seminar	GDIA China Seminar in SHANGHAI	Soonkyu Chung	Shanghai (China)
	21/22/23/24	Symposium	DENTIS WORLD IMPLANT SYMPOSIUM in SPAIN		Madrid (Spain)
Dec.	15	Seminar	LIVE Surgery	Insung Jeon	Seoul (Korea)



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