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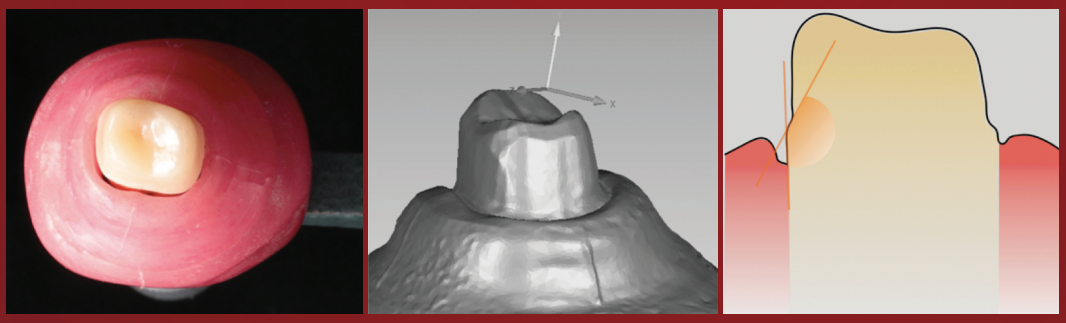
Journal of Prosthodontics and Implantology



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Journal of Prosthodontics and Implantology

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Journal of Prosthodontics and Implantology

Editorial

Maintaining an all-English dental journal in Taiwan is truly challenging. After three years of the pandemic, we have finally resumed regular publication. With the collective efforts of the editorial board, this issue features two original articles and two case reports. Among them, the intraoral scanner is a highly popular impression tool. The two original articles in this issue discuss the precision of IOS applications in different scenarios, while the two case reports focus on the application of dental implants.

We express our sincere appreciation to all the authors and reviewers for their contributions. Without your support and dedication, we would not have been able to successfully complete this edition. Additionally, we would like to thank our readers for their support and attention. You are our constant motivation to persevere.

If you have any questions or suggestions regarding this issue, please don't hesitate to contact us. We look forward to providing you with high-quality dental content in future publications.

Best regards,

Li-Deh Lin

Li-Deh Lin, Editor-in-Chief

The Academy of Prosthetic Dentistry R.O.C., Taiwan

Original Article

Influence of Different Depths of Finishing Lines of Single Crown Abutments on Marginal Definition and Emergence Profile Reproducibility in Intraoral Scanning: An *In Vitro* Pilot Study

Wei Jyun Ciou,[a*] Yao Ning Lei,[b*] Ting Wei Lin,[c] Wei Hung He,[d]

[*] co-first authors

[a]Kaohsiung Chang Gung Memorial Hospital Dentistry School of College of Dental Medicine, Kaohsiung Medical University. D.D.S. (2011/9-2017/7)

[b]Kaohsiung Chang Gung Memorial Hospital
1. Dentistry School of College of Dental Medicine, Kaohsiung Medical University. D.D.S. (1991/9-1997/7)
2. Graduate Institute of Clinical Dentistry School of Dentistry, Kaohsiung Medical University. M.S. (2002/9-2004/7)

[c]Kaohsiung Chang Gung Memorial Hospital Dentistry School of College of Dental Medicine, Chung Shan Medical University. D.D.S.

[d]Kaohsiung Chang Gung Memorial Hospital
1. Dentistry School of College of Dental Medicine, Kaohsiung Medical University. D.D.S. (1999/9-2005/7)
2. Graduate Institute of Clinical Dentistry School of Dentistry, Kaohsiung Medical University. M.S. (2005/9-2007/7)
3. Herman Ostrow School of Dentistry of University of Southern California. Advanced Prosthodontics Certificate. (2015/6-2018/8)

Corresponding author:
Wei Hung He
Kaohsiung Chang Gung Memorial Hospital
1. Dentistry School of College of Dental Medicine, Kaohsiung Medical University. D.D.S. (1999/9-2005/7)
2. Graduate Institute of Clinical Dentistry School of Dentistry, Kaohsiung Medical University. M.S. (2005/9-2007/7)
3. Herman Ostrow School of Dentistry of University of Southern California. Advanced Prosthodontics Certificate. (2015/6-2018/8)

No. 123, Dapi Road, Niaosong District, Kaohsiung City, 833
Tel : 07-7317123-2378
Fax: 07-7317123
Email: hmj058@gmail.com

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Abstract

Purpose: *This study aimed to evaluate the definition of the finishing line and emergence profile reproducibility of a single crown abutment, at different relative heights between the finishing line and the gingival crest, by intraoral scanning.*

Materials and methods: *A typodont upper right first molar was prepared for a single crown abutment. The tooth was mounted on the spindle of the spiral micrometer, and the artificial gingiva was fixed on the frame beside the spindle. Relative vertical position of the gingival crest and the finishing line of the abutment tooth were changed by rotating the spiral micrometer. The depth settings of the gingival margin were as follows: supra-gingiva, 0.5 mm (sup 0.5); equal gingiva (equ); sub-gingiva, 0.5 mm (sub 0.5); and sub-gingiva, 1.0 mm (sub 1.0). Two different brands of intraoral scanners (IOSs) were used in this experiment: 3Shape Trios 3 and Primescan to acquire each depth setting of five scans, and the scan results were output in STL format. 3D engineering software was used to align and superimpose the images. The angle between the finishing line slope of the abutment tooth and the root was measured in the same longitudinal section. The difference in angle between the scan results and the original model was compared and analyzed.*

Results: *For the 3Shape IOS, sub 1.0 (138.2±5.7°) < equ (150.3±1.0°) and supra 0.5 (149.7±2.7°) ($p<0.05$); sub 0.5 (142.9±2.5°) < equ (150.3±1.0°) and supra 0.5 (149.7±2.7°) ($p<0.05$) among all settings. For the Primescan IOS, there were no significant differences among all settings ($p>0.05$).*

Conclusions: *The submarginal contour and finishing line definition acquired by intraoral scanners were significantly affected by the vertical relationship between the finishing line and the gingival crest. Equal-gingival and supra-gingival finishing lines had clear scanning results and correct sub-marginal appearance in different intraoral scanners. However, when performing subgingival digital impressions, special attention must be paid to whether the intraoral scanner can provide the desired results.*

Introduction

A good impression should clearly record the entire finishing line of the preparation, along with some portion of the unprepared teeth below the finishing line. The structure above the finishing line may ensure marginal fit of the prosthesis, and the structure under the finishing line may help determine the appropriate extension of the prosthesis, such as the emergence profile.

In the case of traditional impressions, clinically acceptable results can be obtained by proper gingival management before taking impressions [1,2]. Digital impressions are now widely used clinically and studies have confirmed that they can achieve a clinically acceptable marginal fit [3, 4].

It is difficult to acquire accurate information about the tooth structure under the gingival margin for full crowns with equal-gingival or sub-gingival margins because of interference by the gingiva. Studies involving digital impressions have shown that accuracy of the margin obtained by intraoral scanning is affected by the relative position of gingiva and finishing line of the abutment.[5]

Keeling et al.[5] performed a study to simulate the different confounding factors affecting the marginal quality of an intraoral scan. The study pointed out that subgingival scanning is often easily deformed. Deformation is characterized by obtuse angles and unclear margins. Cagidiaco et al.[6] attempted to divide 60 intraoral single crown abutment teeth according to the depth of the finishing line: supra-gingival margin, 0.5–1.0 mm into the sulcus and 1.5–2.0 mm into the sulcus. Digital impressions are not recommended when the crown margin is 1.5–2.0 mm into the sulcus. In this study, it is difficult to accurately control the marginal gingival height. Therefore, we designed an experiment to precisely control the height of the gingival margin and evaluate the accuracy of the finishing line by intraoral scanning under quantitative conditions.

The purpose of this study was to evaluate and determine the relative position between the finishing line of a single crown abutment and the marginal gingival height that can be used to achieve acceptable accuracy and reproducibility of the emergence profile during intraoral scanning. Understanding these parameters may help surgeons better determine the appropriate depth of gingival margin when using intraoral scanners clinically, which is conducive to acquiring clear margins and good emergence profiles during the subsequent production of the prosthesis.

Material & methods

Fabrication of the standard model

1. A typodont upper right first molar was prepared for a single crown abutment (Figure 1). The tooth was mounted on the spindle of a spiral micrometer with a disk-shaped magnet embedded at the bottom of the tooth.
2. An acrylic artificial gingiva (Hygenic Repair Acrylic, Coltene Whaledent) was fixed on the frame beside the spindle with the contour of the gingival crest parallel to the abutment margin, 0.5 mm apart horizontally (Figure 2).

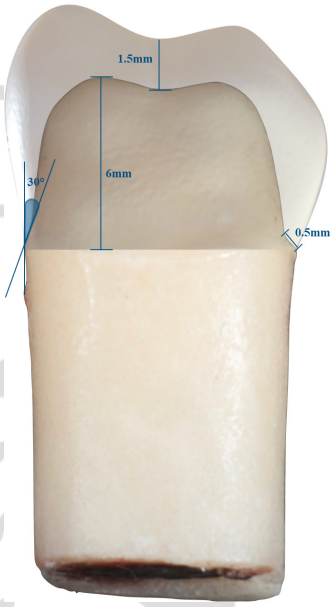

Figure 1. Right maxillary first molar single crown abutment (height: 6 mm; occlusal reduction: 1.5 mm; marginal width: 0.5 mm; marginal pattern: 30°light chamfer)

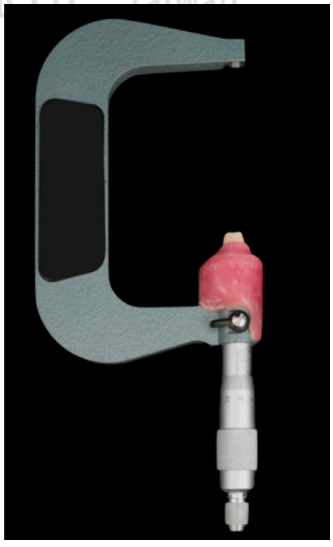

Figure 2. Fabrication of acrylic artificial gum (Hygenic Repair Acrylic (Coltene Whaledent) on the frame of a micrometer

3. As the spiral micrometer rotates, the spindle (tooth) moves relative to the frame (gingiva), thereby simulating the relative position of the finishing line from the supra-gingiva to sub-gingiva. (Figure 3)
4. The spiral micrometer was rotated according to the reading to accurately control the vertical distance between the gingiva and the finishing line.
5. The depth settings of the gingival margin were as follows: supra-gingiva, 0.5 mm (sup 0.5); equal gingiva (equ); sub-gingiva, 0.5 mm (sub 0.5); sub-gingiva, 1.0 mm (sub 1.0).

Acquisition of the digital model using an intraoral scanner

Two different brands of intraoral scanners (IOSs) were used in this experiment: 3Shape Trios 3 (3Shape) and Primescan (Dentsply Sirona) to acquire each depth setting of the five scans, and the scan results were output in STL format, for a total of 40 samples.

3-dimensional digital model superimposition and analysis:

3D engineering software (Geomagic Control X) was used to align and superimpose the images (Figure 4). The angle between the slope of the finishing line of the abutment tooth and the root was measured in the same longitudinal section (Figure 5). The difference between the angles of the scan results and the original model was compared and analyzed.

Statistical Analysis

Statistical analyses using one-way ANOVA was performed to record the following:

1. The influence of the depth of gingival margin on the accuracy of scanning.
2. Comparison of the accuracy of two intraoral scanners at different depths of the gingival margin.

Results

Table 1 shows the difference between the angles of each group and the real angle using nonparametric statistics. The clinically acceptable threshold of the emergence profile angle was defined as ±10° in this experiment. We think there may be insufficient clinical reference value if the emergence profile angle deviation is greater than 10°.

Using one-way ANOVA nonparametric statistics, the following observations were recorded:

1. 3Shape: With sup 0.5, equ, sub 0.5, and sub 1.0 settings, the means were 149.7±2.7°, 150.3±1.0°, 142.9±2.5°, and 138.2±5.7°, respectively, where sub 1.0 (138.2±5.7°) < equ (150.3±1.0°) and supra 0.5(149.7±2.7°) ($p<0.05$); sub 0.5(142.9±2.5°)<equ(150.3±1.0°) and supra 0.5 (149.7±2.7°) ($p<0.05$) (Figure 6).
2. Primescan: With supra 0.5 (148.6 ± 3.1°), equ (151.1 ± 3.5°), sub 0.5 (141.9 ± 2.0°), and sub 1.0 m (148.2 ± 1.5°), there was no significant difference between the groups ($p >0.05$) (Figure 7).
3. 3Shape sub 0.5 and sub 1.0 were observed to be significantly different from the other groups in this experiment ($p<0.05$) (Figure 8).

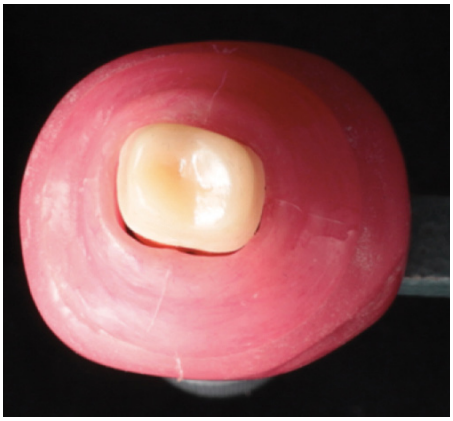

Figure 3.
On the micrometer, the main axis (tooth) moves relative to the frame (gum), and this is used to simulate the relative position of the finishing line from supra-gingiva to sub-gingiva.

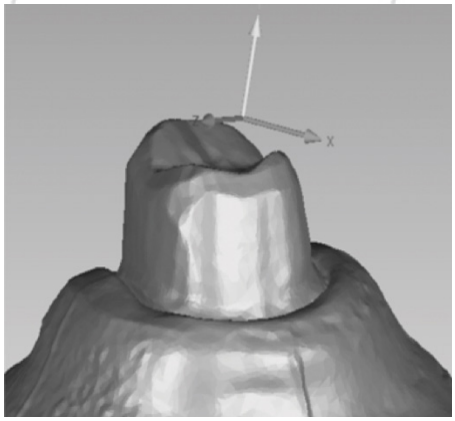

Figure 4.
A three-dimensional engineering software (Geomagic Control X) is used for image superimposition and alignment

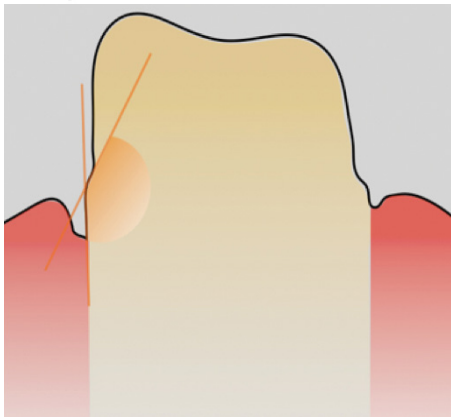

Figure 5.
The angle between the slope of the finishing line of the abutment tooth and the root is measured in the same longitudinal section

Table 1. Nonparametric statistics of angular differences between each group and actual angle. The clinically acceptable threshold of the emergence profile angle was defined as ±10° in this experiment.

Intraoral scanner \ Depth	sub 1.0	sub 0.5	equ	sup 0.5
3Shape (Clinically acceptable)	**-11.8±5.7** (Unacceptable)	**-7.1±2.5** (Acceptable)	**0.3±1.0** (Acceptable)	**-0.3±2.7** (Acceptable)
Primescan (Clinically acceptable)	**-1.8±1.5** (Acceptable)	**-0.9±2.0** (Acceptable)	**1.1±3.5** (Acceptable)	**-1.4±3.1** (Acceptable)

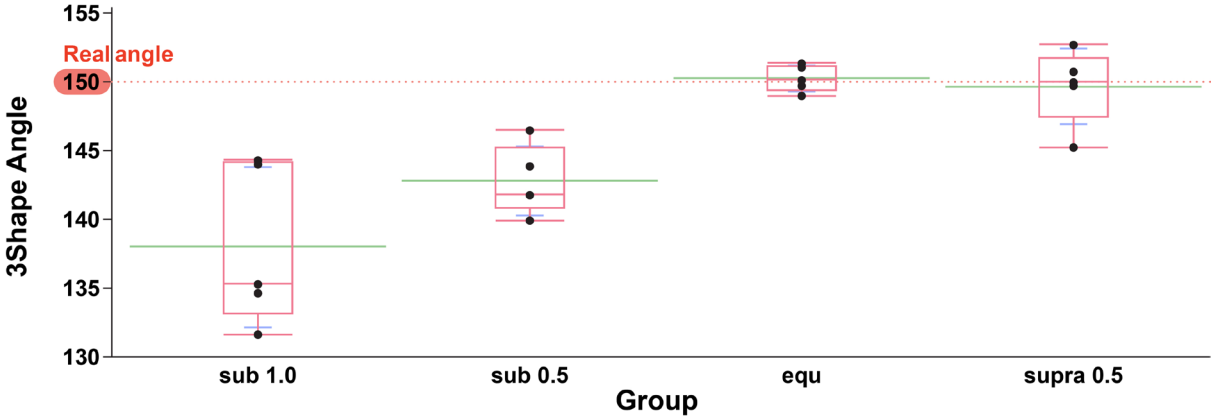

Figure 6. 3Shape scan box plots of different finishing line depths.
sub 1.0 < equ and supra 0.5, which is a statistically significant difference (p<0.05).
sub 0.5<equ and supra 0.5, which is a statistically significant difference (p<0.05).

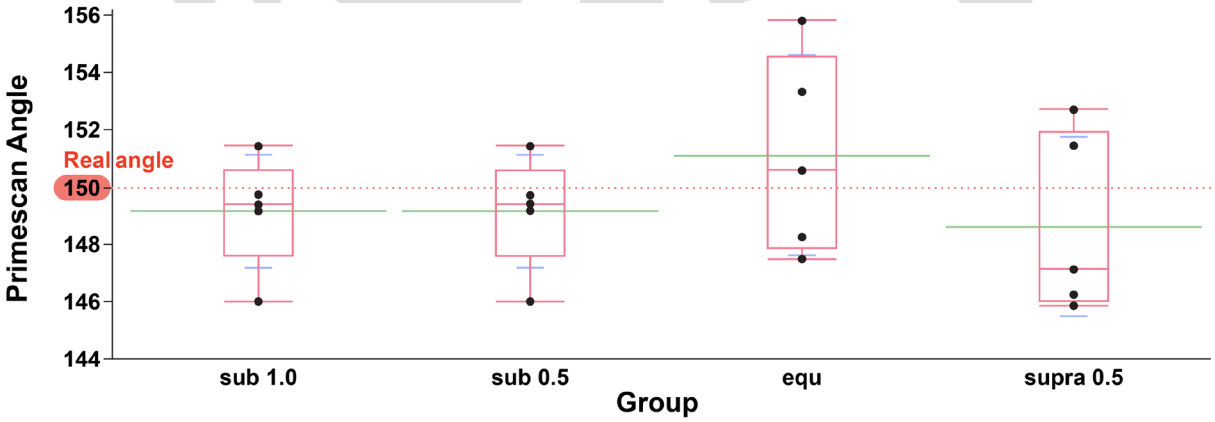

Figure 7. Primescan scan box plots of different finishing line depths
No significant difference between the groups (p >0.05)

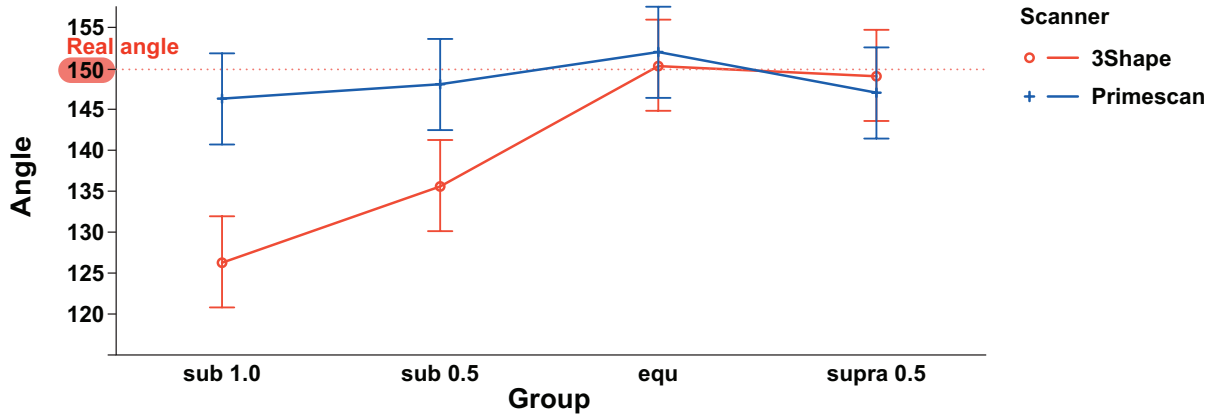

Figure 8. At sub 0.5 and sub1.0, 3Shape scan results were significantly different from other groups in this experiment.

Discussion

According to our results, the deeper vertical position of the finishing line we set, the less accurate of the emergence profile we would get with digital impression.

The present study shows that the angle deviation that can be used clinically to estimate the emergence profile was determined to be 10°, and the results of each experimental group were acceptable except for four scan samples out of the five samples in the 3Shape sub 1.0 group. Du et al.[7] measured 148 upper incisors and found that the angle between the cervico-enamel junction and the root surface was 11.30°–15.26°, which shows that the angle deviation that can be used clinically to estimate the emergence profile was determined to be 10°. The results of our each experimental group were acceptable except for four scan samples out of the five samples in the 3Shape sub 1.0 group (Table 1). Acquiring the emergence profile contributes to determining where the real finishing line is based on the angle transition, which reduces the chance of incorrect margin setting during prosthesis fabrication. The depth of the finishing line should be set according to the data recommended by our study when using an intraoral scanner clinically.

Zimmermann et al.[8] performed an in vitro study to determine the local accuracy of single crown preparations with different intraoral scanners and concluded that the accuracy of Primescan (Dentsply Sirona) is not significantly different from the traditional impression at the gingival margin but is significantly better than Trios 3 (3Shape). Although only the equal gingival abutment margin was evaluated, the results were similar to the different accuracies of the sub-gingival settings with the two different brands of intraoral scanners used in this experiment. This may be the result of different acquisition techniques and software algorithms used in various systems. The measurement principles of the intraoral scanners used in this experiment were as follows: Trios 3 (3Shape), confocal method; Primescan (Dentsply Sirona), triangulation method[9]. Many brands of intraoral scanners are available in the market and if the manufacturers do not provide relevant information, surgeons must determine whether the scanners meet their requirements.

These experimental results indicate that deeper sub-gingival digital impressions are more inaccurate and that different brands of intraoral scanners perform differently in the sub-gingival areas. This study recommended that the depth of the subgingival finishing line should not exceed 0.5 mm to ensure that the supra-gingival finishing line and emergence profile are more accurate; therefore, it is recommended that the margin of the digital impression be maintained above the gingiva, and if necessary, 0.5 mm within the gingiva. In case the margin is deeper, the dentist must either clinically perform a gingivectomy or make a traditional impression to meet the requirements.

Keeling et al.[5] scanned the typodont abutment tooth, and the results showed that the curvatures of the supra-gingival and equal-gingival finishing lines were significantly different. Compared with the supra-gingival finishing line, the image of the equal-gingival finishing line had a larger curvature and poorer definition. Our experimental design further analyzed the subgingival margin and quantified its different depths.

Cagidiaco et al.[6] performed an in vivo study in which the scanning results of Aadva IOS 100 (GC) and the laboratory-scanned traditional impression casting model were superimposed by Exocad software, applying the best-fit algorithm to align the scan of the conventional with the digital impressions. The authors concluded that digital impression is not recommended when crowns' margins are positioned deep (1.5–2 mm) into the sulcus. Our experiment applied two commonly used intraoral scanners to provide more references and the results are based on marginal definition and angle measurement. A similar result was obtained, in that for deeper subgingival finishing lines, their acquisition by intraoral scanners is more difficult.

Concerning traditional impressions, Finger et al.[2] performed an in vitro model study when the gingival retraction width was 200 μm; therefore, providing an opportunity to reproduce the 2 mm area under the gingiva crest due to fluidity of the precise elastic impression material. According to the results of our study, for a clinically subgingival marginal depth of 0.5 mm or more, it is uncertain whether the tooth preparation can be clearly scanned. In addition, when the emergence profile is important (such as the veneer cases in the anterior teeth), traditional impressions are recommended.

Our study has certain limitations. Firstly, although the typodont abutment and acrylic artificial gingiva can simulate the actual appearance of a tooth, these cannot display the true optical

characteristics. Secondly, the use of a typodont abutment and acrylic artificial gingiva in this study eliminates factors like gingival crevicular fluid, blood, saliva, and moisture during breathing.

The experiment by Keeling et al.[5] showed that factors such as marginal proximity to adjacent teeth, height of adjacent teeth will interfere with the viewing angle of the intraoral scan and affect the accuracy. However, our experimental design did not simulate adjacent teeth. In addition, Richert et al.[4] also pointed out that it is necessary to obtain higher accuracy of the intraoral scan model according to a specific scanning path; Keeling et al. [5] also showed that when making digital impressions, the simulated intraoral environment restricts the surgeon's hand holding posture and the scanner's access to the tooth. This factor was not considered in this experiment and the procedure may be more challenging clinically.

In the future, further research must be carried out to support our conclusions and overcome the challenges of clinical application of intraoral scanning systems.

Conclusions

1. The digital impression was based on supra-gingival preparation as much as possible so that more accurate margin and emergence profile could be obtained.
2. Different intraoral scanners showed different scanning details of the sub-gingival margin; therefore, surgeons must be attentive while using intraoral scanners to obtain satisfactory clinical results.
3. Primescan (Dentsply Sirona) was more suitable for digital impression of the sub-gingival finishing line, but the performance of the two intraoral scanners was similar to the recommended value of our experiment.

Conflicts of Interest:

There are no conflicts of interest.

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Original Article

Evaluating the influence of different light conditions on scanning trueness

Yu-Lun Cheng, DDS
Division of Prosthodontics, Department of Dentistry, Kaohsiung Medical University Hospital, Kaohsiung Medical University, Kaohsiung, 80708, Taiwan.

Jen-Hao Chen, DDS, MS, PhD, Je-Kang Du, DDS, MS, PhD, Chun-Cheng Hung, DDS, MS, PhD, Jen- Chyan Wang, DDS, MS, Ting-Hsun Lan, DDS, MS, PhD*
Division of Prosthodontics, Department of Dentistry, Kaohsiung Medical University Hospital, Kaohsiung Medical University, Kaohsiung, 80708, Taiwan.
School of Dentistry, College of Dental Medicine, Kaohsiung Medical University, Kaohsiung,
80708, Taiwan.
Running title: IOS Trueness of different light conditions

Corresponding author:
Dr. Ting-Hsun Lan
School of Dentistry, College of Dental Medicine, Kaohsiung Medical University, 100 Shin-Chuan 1st Road, Sanmin District, Kaohsiung 80708, Taiwan
Phone : +886-7-3121101 ext. 7003
Fax: +886-7-3157024
Email: tinghsun.lan@gmail.com

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Abstract

Aims: *This in vitro study aimed to compare the trueness of maxilla and mandible full-arch optical scans using one scan path with five different light conditions.*

Materials and methods: *Standard maxilla and mandible models were set in a dental chair using a holder to simulate position and posture. The reference models' Standard Tessellation Language files were formatted using a desktop scanner, and the operative model's files were obtained using an intra-oral scanner (Trios 3 Pod) and superimposed using Exocad DentalCAD software. The same scan path was designed to scan ten times per jaw with five light conditions (room daylight [Original], unit [UL], white [WL], green [GL], orange [OL]), creating 100 scan files that were then compared with the reference files. The maximum deviation of each tooth was recorded, and statistical analysis used one-way analyses of variance followed by Tukey's post hoc test.*

Results: *The trueness of the optical impression for the full arch using one path differed between the maxilla and mandible and depended on the different light conditions ($P < 0.05$). In the same path, peak deviation was found at the turning points for the left central incisor, left first premolar, left second molar, and right second molar in the maxilla, and for the right first premolar, right second molar, and left second molar in the mandible. The Original condition showed the lowest deviation (0.121 ± 0.095 mm) in the maxilla and GL in the mandible (0.072 ± 0.035 mm). The five light conditions did not differ significantly in the maxilla ($P = 0.267$). However, the UL condition differed significantly from the other four light conditions in the mandible ($P = 0.001$).*

Conclusions: *UL is not recommended during the intraoral scan. However, the trueness might be less affected by the different light conditions from the headlamp of the loupes during an optical intra-oral scan.*

Key words: Light conditions, trueness, full-arch scan, intra-oral scanner

Introduction

In the digital dentistry era, dentists increasingly use the intra-oral scanner (IOS) in clinical treatment to replace the traditional impression.[1,2] From image capture, software design, and biomaterial selection to manufacturing type, digital dentistry is changing the treatment process.[3,4] However, artificial intelligence,[5] augmented/virtual reality,[6] navigation,[7] or the addition of other biomechanical considerations[8,9] is impacting the dental treatment concept.

The pioneering IOS device used in clinical dentistry was the CEREC system in 1987.[10] Many IOS devices have been launched in dentistry and are gaining popularity in dental offices in the past decade.[11] The accuracy studies for most IOSs have been compared and validated in meeting clinical needs, and the accuracy of some IOSs even exceeds traditional silicone impression materials.[12,13] Conversely, the accuracy of IOSs has been shown to deviate significantly depending on the model, scanning field, scanning strategy, and environmental disturbances. Kim et al.[14,15] showed significant deviations between different IOSs ranging from 17.80 to 200.24 μm. In addition, Medina-Sotomayor[16] stated that full-arch scanning still had limitations and discrepancies, although using IOS devices for single crown work is increasingly popular.

While recording the digital data of the full dental arch is very useful for full mouth rehabilitation, correcting and verifying its limitations and errors is necessary. Richert et al.[17] reviewed articles and highlighted that saliva, blood, rebound after gingivae, patient's mouth-opening durability, and cheek and tongue movement would affect oral scan quality. Arakida et al.[18] demonstrated that ambient light of 3900 K and 500 lux is suitable for taking optical impressions.

Dentists use a magnifying glass, known as loupes, in clinical applications to help them see small details more clearly.[19] This allows them to perform procedures such as filling cavities, placing crowns, and performing root canals with greater precision and accuracy, improving the overall outcome of the treatment for the patient. A headlamp provides additional lighting, which can help the dentist see small details more clearly. This additional lighting can be beneficial when the natural lighting in the room could be more optimal or when the dentist works in an area that is difficult to access with traditional overhead lighting.[20] Additionally, a headlamp allows the dentist to position the light source directly where needed, which can be more efficient than attempting to position the patient or chair to get the best lighting.

Loupes with headlamps often have different light color options because different colors of light can affect visibility and color perception differently. A cool white light could provide a bright, clear view of the teeth and gums, and a warm white light could provide a more realistic scenery of the teeth and gums and help reduce glare and reflections.[21] Some loupes with headlamps also have a red light, which can be beneficial for specific procedures such as endodontics since it helps to reduce the glare on metal surfaces and the visibility of blood, making it easier for the dentist to see the inside of the tooth.[22] Since green light is less intense than white light, it can be less harsh on the eyes and may cause less eye fatigue for the dentist. In addition, green light is a neutral color, so it does not affect the color perception of the teeth and gums; it can be helpful for the color matching of restorative materials and natural teeth.[23] Moreover, some headlamps also come with UV light options[24] that can be used to detect the fluorescence of the dental materials and teeth, helping the dentist identify the decay's specific location.

Wesemann et al.[25] used the dental model in a box with different ambient light sets, showing that the ambient light would influence the accuracy and scanning time of IOSs. Ochoa-López et al.[26] showed that ambient light influenced the accuracy and scanning time of IOSs, and the effect was different for all devices. Revilla-León et al.[27,28] used the lower model, showing similar results with aforementioned study and revealing that Trios 3 provided better accuracy and mesh quality. In a clinical study, Revilla-León. et al. [29] showed that light conditions significantly influenced the scanning accuracy of the IOS. The higher the extension of the digital scan performed, the lower the accuracy values obtained.

To evaluate the influence of ambient light in oral scans of the maxilla and mandible, this *in vitro* study aimed to measure the impact of various ambient scanning light conditions on the accuracy of intra-oral scanning. The null hypotheses were: (i) that no significant differences would be found in either the maxilla or mandible for the digital scan trueness of the same IOSs and (ii) that no significant differences would be found under the five different ambient scanning light conditions in one jaw.

Methods and Materials

1. Pre-scan preparation

A dental simulator model (Nissin Dental Products, Inc., Kyoto, Japan) put in a Nissin Simple Manikin II (Nissin Dental Products, Inc.) was set on a dental chair to simulate the clinical condition. The model was initially scanned with a desktop scanner (E4; 3Shape, Copenhagen, Denmark) to obtain initial STL files. The Trios 3 Pod Scanner (version 19.2.4; manufactured 2017-12; 3Shape) is an IOS system commonly used clinically; it was calibrated according to the manufacturer's guidelines. An experienced right-handed dentist performed all scans, keeping an arch scan under 1500 sheets of image.

2. Scan strategies

The original model was scanned using a desktop model scanner (3Shape E4 scanner) and an IOS (3Shape Trios 3). The model was set on the unit to simulate a real patient position and scanned ten times under five different light conditions by this IOS. The scan strategy followed the manufacturer's guidelines (Figure 1). For the maxilla, the occlusal surface begins, starting at the left second molar, continuing to the right second molar, returning through the palatal surface, and finally sweeping the buccal surfaces. The mandibular path begins at the occlusal side of the second molar in quarter III, progresses longitudinally along the dental arch, ends at the right second molar, continues lingually through the arch, and finally completes the buccal arch. Then, an experienced dentist performed each condition ten times, with 100 scans recorded.

The same dentist performed all test scans in the same room under similar temperatures (22°C), relative humidities (60%), and five different light conditions with the same distance and angles. The different light sources were set at room daylight (Original); unit light (UL); white light (WL), green light (GL), and orange light (OL) from the loupe headlight (Figure 2).

(1) For the Original group, the chair's light was turned off, and only the ceiling light was used, with no windows or natural light. The illuminance of the room was 1003 lux as measured using the same light meter.

(2) For the UL group, in a room with a dental chair (A-dec 500; A-dec, Newberg, OR, USA), the chair's LED light had an intensity of 15000 lux and 5000 K and was oriented 45° at 66 cm from the dental model.

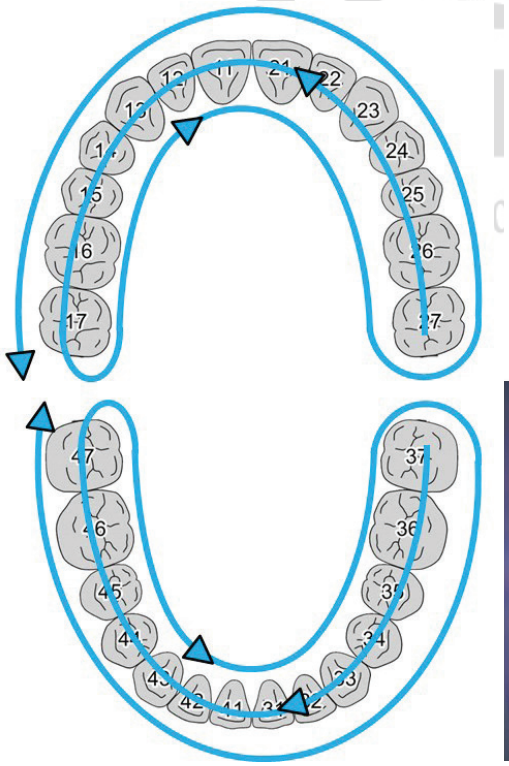

Figure 1. The scan path follows the manufacturer's guidelines.

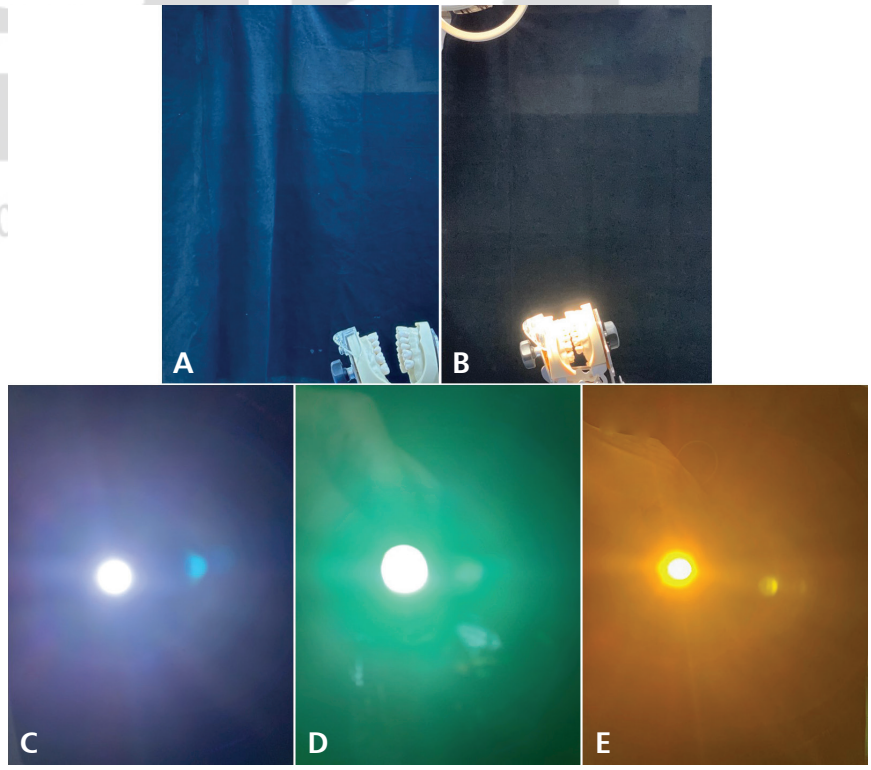

Figure 2. SThe different light source was set at (A) room daylight (Original), (B) unit light (UL), (C)white light (WL), (D) green light (GL), and (E) orange light (OL).

(3) For the WL group, not subgroup of the loupe headlight group, the loupe's LED light had an intensity of 50000 lux and 5600 K (Snap On Optics, Phoenix, AZ, USA).

(4) For the GL group, not subgroup of the loupe headlight group, the loupe's LED light had an intensity of 50000 lux and 4100K (Snap On Optics).

(5) For the OL group, not subgroup of the loupe headlight group, the loupe's LED light had an intensity of 50000 lux and 2500K (Snap On Optics).

Trueness was defined by comparing a test dataset with a reference dataset and determining the scanner's true accuracy. The difference between the model's measured point and the superimposed model's furthest corresponding point could be calculated using the "Best Fit Match" and "Cutting View" tools in a CAD software program (Exocad DentalCAD; Exocad GmbH, Santa Clara, CA, USA). One model recorded fourteen teeth with maximum deviations, and 1400 data points were recorded for two jaws. Figure 3 shows deviations between the scanning and reference models with different light sources.

3. Statistical analysis

Seven hundred data points were recorded for each jaw for the trueness comparisons. Descriptive statistics were used to present the data in each group. Groups were compared using one-way variance analysis with Turkey's post hoc test using IBM SPSS Statistics for Windows (version 20; IBM Corp, Armonk, NY, USA). A $P < 0.05$ was considered statistically significant for all tests.

Results

The mean absolute deviation among the five light conditions was 0.132 ± 0.110 mm in the maxilla and 0.081 ± 0.054 mm in the mandible. The statistical results indicated a significant interaction between the upper and lower jaws ($P < 0.05$).

For trueness, the maximum mean deviations are shown in Table 1. Figure 4 shows the maximum deviation of different tooth positions among five light conditions in the maxilla. The mean deviation was largest in the UL group (0.146 ± 0.108 mm) and smallest in the Original group (0.121 ± 0.095 mm). However, the trueness of each tooth position in the oral scan did not differ significantly between the various light conditions and the original light source.

Figure 5 shows the maximum deviation of different tooth positions among the five light conditions in the mandible. The mean deviation was largest in the UL group (0.096 ± 0.071 mm) and smallest in the GL group (0.072 ± 0.035mm). In addition, the trueness of the oral

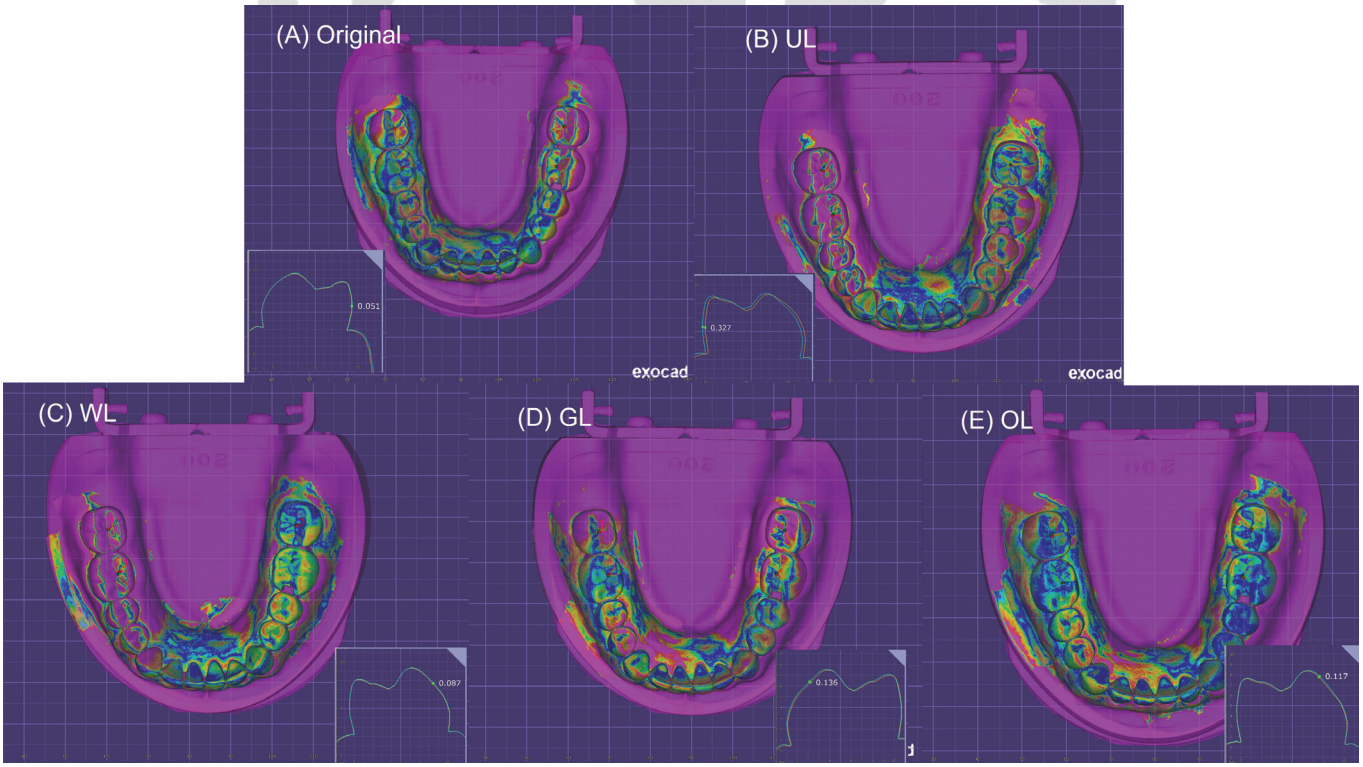

Figure 3. Color code showing deviations for (A) original, (B) UL, (C) WL, (D) GL, and (E) OL scans with the reference model.

Table 1. Maximum mean absolute maxilla and mandible deviation (unit: mm).

	Maxilla			Mandible		
	Mean ± SD	95%CI	*P*-value	Mean ± SD	95%CI	*P*-value
Original	0.121 ± 0.095	(0.105, 0.136)	0.267	0.076 ± 0.060[a]	(0.069, 0.083)	0.001
UL	0.146 ± 0.108	(0.128, 0.164)		0.096 ± 0.071[b]	(0.087, 0.104)	
WL	0.127 ± 0.098	(0.111, 0.143)		0.080 ± 0.065[a]	(0.072, 0.087)	
GL	0.140 ± 0.141	(0.117, 0.164)		0.072 ± 0.035[a]	(0.068, 0.035)	
OL	0.126 ± 0.102	(0.108, 0.143)		0.079 ± 0.058[a]	(0.072, 0.086)	

Different superscript letters in a column indicate a significant difference among groups ($P < 0.05$; one-way ANOVA [*K* independent sample] with Tukey's post hoc test).

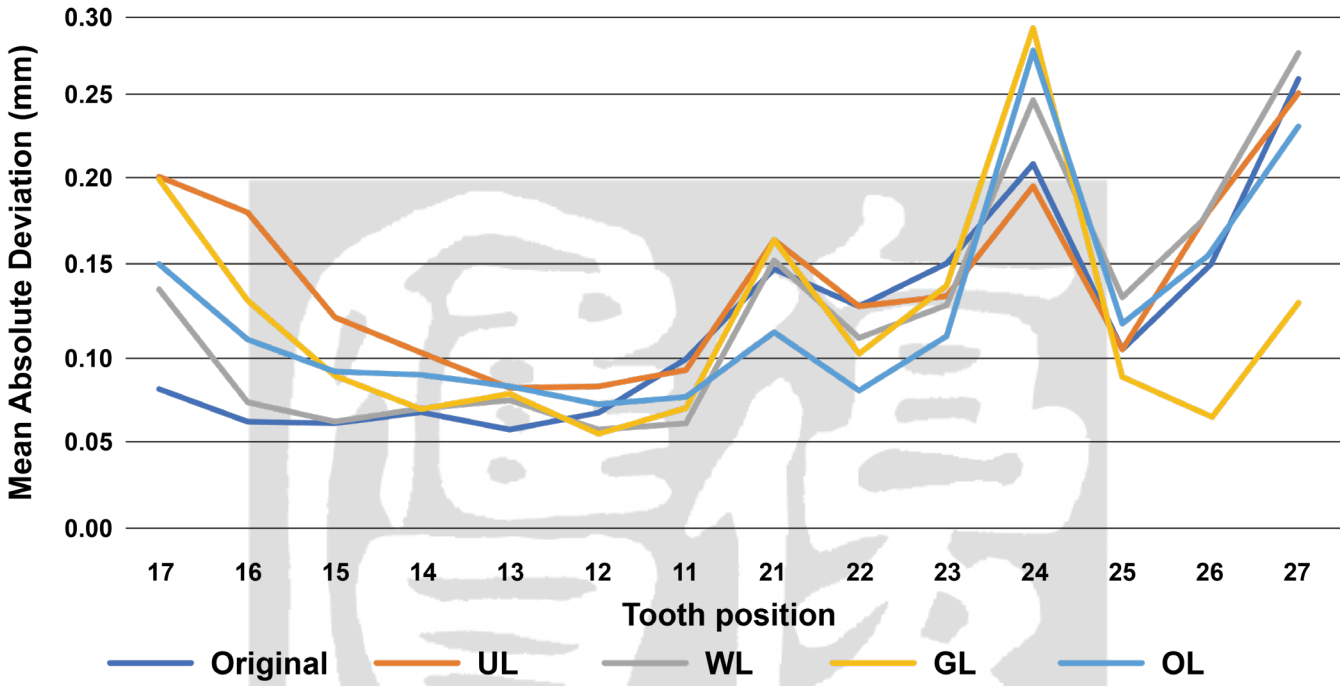

Figure 4. Mean deviations at different tooth positions among five light conditions in the maxilla.

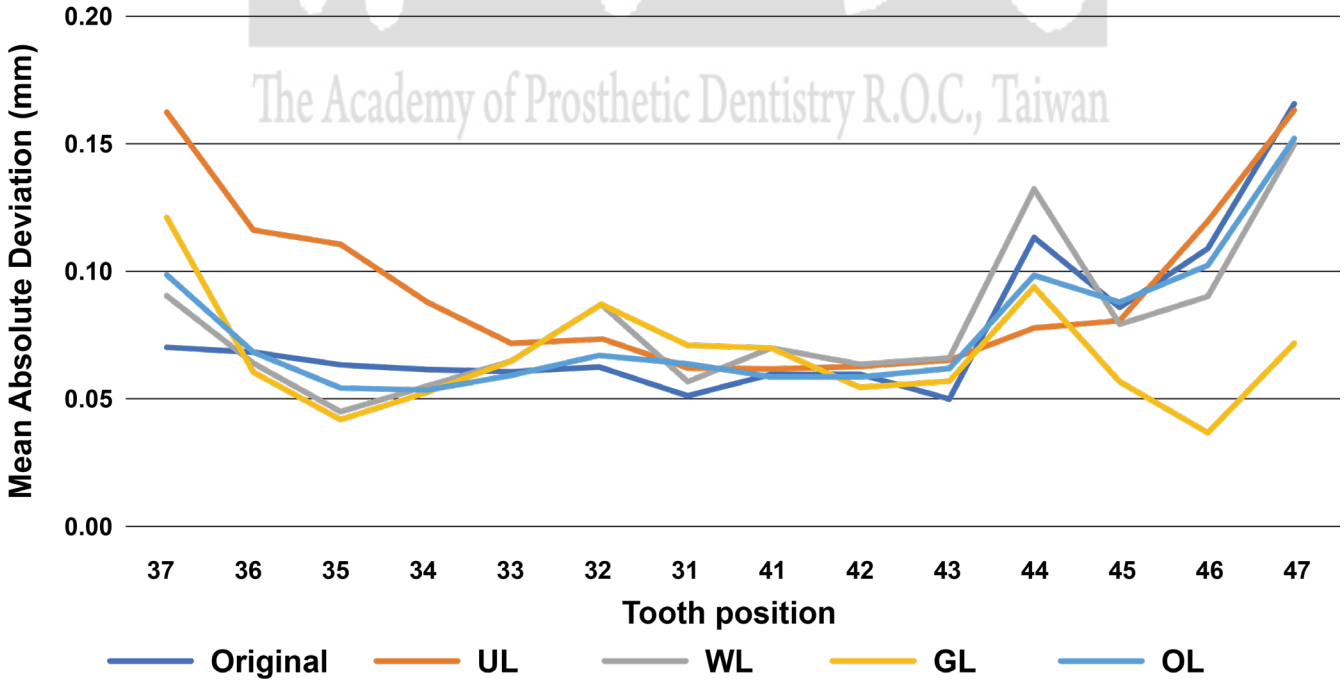

Figure 5. Mean deviations at different tooth positions among five light conditions in the mandible.

scan was significantly influenced by the different light conditions, especially the UL ($P = 0.001$).

Discussion

This in vitro study evaluated the impact of various ambient scanning light conditions on the accuracy of an IOS, finding that UL affected the trueness of the IOS of the mandible. The null hypothesis was rejected. The original light source provided similar data to Feng et al.[30] This study showed a similar value in the deviation of trueness to the findings of Kim et al.[14,15] Constructing the 3D model from the IOS would cause larger deviations in the curved areas of the dental arch, such as premolars, canines, and the distal surface of the molars, which require more angles to be flipped during capture. These deviations could be attributed to the inevitable shaking and movement when holding the IOS or the limitations of the Trios 3 system. In the maxilla, the larger deviations in the linear movement at the left first premolar than the right first premolar might be attributed to changes in the lens focus during the move when converting a straight line into a curved surface, which would necessarily create a defocused image. Feng et al.[30] showed that the maxilla would be affected significantly more than the mandible, consistent with the findings of this study.

Revilla-León et al.[27,28] used the lower model to compare trueness in different ambient lights, finding that Trios 3 provided better accuracy and mesh quality. This study's results are similar but show distinct upper and lower jaw patterns. Wesemann et al.[25] used the dental model in a box with different ambient light sets, showing that ambient light would influence the accuracy and scanning time of IOSs. This study demonstrated that ambient light would significantly affect the lower jaw when setting the model on a dental chair to simulate clinical posture. A clinical study by Revilla-León et al.[29] showed that light conditions significantly influenced the scanning accuracy of the IOS, and the higher the extension of the digital scan performed, the lower the accuracy values obtained. This study provides full arch results that demonstrate the trueness of IOS over the upper and lower jaw. The trueness would be affected by the clinical setting. In the maxilla, turning points and longer scan time would jeopardize the trueness; however, different ambient light conditions did not significantly affect the trueness ($P = 0.267$). In contrast, the lower jaw was relatively stable in different tooth positions; however, dental unit light significantly affected the trueness under different ambient light conditions.

Chang et al.[31] indicated that marginal fit is essential for the longevity of restoration, but the threshold value remains controversial. A mean marginal gap of 50–100 μm has been generally defined as clinically acceptable,[32,33] and 120 μm has been considered the maximum tolerable marginal opening.[34] In this study, the statistical data of deviation in the mandible varied under different light sources; however, the mean values did not differ appreciably (UL = 0.096 mm vs. Original = 0.076 mm), and they were all close to the upper limit of the clinically acceptable range. Even with improvements in the IOS, while the accuracy is gradually approaching the clinically acceptable range for the marginal gap, there remains room for improvement. Therefore, in addition to the continuous improvement of the IOS, it remains necessary to avoid environmental interference, such as light sources (especially UL), during clinical operations.

In clinical practice, the treatment chair and the loupe will illuminate the teeth from different directions and distances. In this study, the irradiation angle and distance were fixed for its consistency. While there will be some clinical differences, under the current setting, it was found that the loupe had no influence on the oral scan, and the UL of the treatment chair produced differences on the jaw. Since Feng et al.[30] highlighted that accuracy was better for the mandible than the maxilla, it is inferred that the light (especially UL) will interfere with the stability of the oral scan. Conversely, since the difference in the upper jaw was significant, even the effect after adding light became more prominent; however, the difference between each after this increase was not statistically significant.

Since a dental model was set on a dental chair in a Nissin holder to simulate the posture, the absence of environmental influences such as saliva, blood, and soft tissue changes is a limitation in this study. Moreover, the reason for UL light affects the result remains unclear and may be related to multiple factors. Therefore, future studies should evaluate the influence of factors such as light wavelength, illumination brightness, illumination distance, and different equipment. In addition, they should compare different IOS and hybrid environmental settings.

Conclusion

Within the limitations of this study, the accuracy of optical impressions for the full arch using one path with five light conditions differed between the maxilla and mandible ($P < 0.05$). In maxilla optical impressions obtained using an IOS, the effect of various light conditions on the oral scan did not differ from the original light source regarding the trueness of each tooth position. The influence of various light conditions differed significantly under the influence of the trueness of the oral scan, particularly for the UL ($P = 0.001$).

Acknowledgments

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Conflicts of Interest

The authors declare no conflicts of interest related to this article.

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Case Report

The conometric concept – definitive rehabilitation with immediate implant and provisionalization by cone-in-cone abutments (Acuris): a clinical report

Kuo-Cheng Fan, D.D.S.
Resident doctor, Dental Department, Shin Kong Wu Ho-Su Memorial Hospital, Taipei, Taiwan
No.95, Wen Chang Road, Shih Lin District, Taipei City, Taiwan
Tel : +886-2-2833-2211 ext. 2170
Fax: +886-2-2838-9321
Email: kelykimo@gmail.com

Chieh-Ming Yu, D.D.S. MSC
D.D.S., Kaohsiung medical University,
M.Sc. in Oral implantology, Goethe university Frankfurt a. M.
Attending Physician, Operating Doctor, Dental Department Shin Kong Wu Ho-Su Memorial Hospital, Taipei, Taiwan
No.95, Wen Chang Road, Shih Lin District, Taipei City, Taiwan
Tel : +886-2-2833-2211 ext. 2170
Fax: +886-2-2838-9321
Email: Jaminzeak@hotmail.com

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Abstract

Cement- and screw-retained implant prostheses are commonly used. The conometric concept is a paradigm shift in prosthetic retention of single crowns that are fixed but retrievable by the clinician. Friction-based retention offers a fixation mode that provides the esthetics of a cement-retained crown while maintaining retrievability and excluding the submucosal residual cement risk. In this case report, we show the clinical feasibility of full mouth rehabilitation of a 44-year-old patient using a cone-in-cone abutment for the immediate implant and provisionalization with an Ankylos implant system (Dentsply Sirona, NY, USA).

Key words: immediate implant, cone-in-cone abutment, conometric concept, virtual design

Introduction

Fixed partial implant reconstructions such as single implant crowns and multiple-unit fixed dental prostheses are well documented in the literature. They have been accepted as suitable treatment options for replacing single or multiple missing teeth.[1] However, their clinical success can be further improved by considering the associated technical and biological aspects, such as using optimal fixation methods between the implant and restoration.

Recently, Bressan and Lops reported favorable results in a study using conic coupling abutments for full-arch fixed prostheses supported by four implants.[2] Bressan et al. also concluded in a recent article that a Morse taper using the conometric concept provided a fixed connection between the implant and dental prostheses upon application of adequate insertion force.[3] Marco et al. also showed the feasibility of using conic coupling connections of immediately loaded temporarily fixed partial restorations.[4]

This case report shows the clinical feasibility of using the conometric concept with the Acuris abutment for immediate provisionalization of implants with an Ankylos implant system (Dentsply Sirona, NY, USA).

Case Report

A 44-year-old male patient presented with chief complaints of dental cavities and malodor under his fixed prostheses. Comprehensive clinical (Figs. 1A and 1B) and radiographic (Fig. 2) examinations showed multiple missing teeth [18, 25, 26, 36], ill-

fitting fixed prostheses in certain areas [11–16, 21–23, 24–27, 33, 34–38], and marginal caries [44–48]. Previous symptomatic root canal treatment of [14, 16, 22, 34, 35, 37, 38, 46, and 47] was also observed. Extra-oral examination showed facial asymmetry and occlusal plane canting (Fig. 3).

Following removal of the ill-fitting prostheses (Figs. 4A and 4B), several teeth [14, 16, 22, 48] were extracted since they were unsuitable for restoration, while others [13, 15, 21, 24, 33, 34, 35, 37, 38, 46, 47] underwent root canal treatment (Fig. 5).

Provisional prostheses were designed digitally (DentalCad; Exocad, Boston, MA, USA) and fabricated by superimposing the intraoral scan (Trios 4; 3-Shape, Copenhagen, Denmark), facial scan (Planmeca ProMax; Planmeca, Helsinki, Finland), and cone beam computed tomography (CBCT) (Planmeca ProMax; Planmeca, Helsinki, Finland) images along the bony and soft tissue landmarks to achieve the ideal facial midline, occlusal plane, and esthetic smile line (Figs. 6A and 6B). Following the delivery of the Cad/Cam PMMA provisional prostheses (Figs. 7A and 7B), mandibular jaw motion was recorded using a jaw movement tracing device (Planmeca 4D Jaw Motion; Planmeca, Helsinki, Finland) for temporomandibular joint (TMJ) analysis, corroborating a clinical setting for anterior guidance and cusp angle.

Following CBCT image analysis and discussion with the patient, the definitive treatment plan included single zirconia crowns and implants as follows: immediate implant placement for 22, delayed implant placement for 14 and 36; delayed implant placement with internal sinus lift for 16 and 26 (Figs. 8A-8E); and single zirconia crowns for 11, 12, 13, 15, 21, 23, 24, 27, 33, 34, 35, 37, 38, 44, 45, 46, and 47.

Figs. 9A and 9B show the abutment teeth and residual ridge condition after disease control. After 12 weeks of adjustments to dynamic equilibrium from TMJ and occlusion, the implant site was prepared for surgery. A surgical guide was designed digitally by superimposing the CBCT images and provisional prostheses.

The implant surgery was performed using the surgical guide and conical connection implant system (Ankylos; Dentsply Sirona, NY, USA). Tooth 22 was extracted, and a ø3.5 × 11 mm implant was placed immediately, while ø3.5 × 9.5 mm and ø3.5 × 11 mm implants were placed flapless over the 14 and 36 areas. The implant sites for 16 and 26 were prepared for sinus elevation using an internal sinus lift kit (Digital Sinus Guide Kit; Avansur Inc, Taichung, Taiwan), and ø4.5 × 8 mm and ø3.5 × 8 mm implants were inserted using the open flap technique (Figs. 10A and 10B).

Following a three-week healing period, the suture was removed, and Acuris abutments (Ankylos; Dentsply Sirona, NY, USA) were chosen sequentially (ø3.3 mm/0°/GH 3.0 mm for 14 and 22; ø4.5 mm/15°/GH 1.5 mm for 16; ø4.5 mm/0°/GH 3.0 mm for 36; and ø4.5 mm/0°/GH 1.5 mm for 26) and delivered using 25 Ncm for one-piece abutment (ø3.3 mm/0°) and 15 Ncm for two-piece abutment torque as recommended by the manufacturer (Figs. 11A and 11B). Then, the temporization caps were set, and provisional crowns were relined and reinstalled for early implant loading (Fig. 12). The temporary cap with a prosthesis can be easily snapped in with friction and is cement-free. Periapical radiographs and panoramic film were used to check the abutments' fit (Fig. 13).

During the one-month adaptation period, appropriate impression caps were aligned for definitive prostheses impressions (Figs. 14A and 14B). The single cord gingival retraction technique and polyether (Impregum Penta Soft Medium Body; 3M ESPE, Minnesota, USA) were used for close tray impressions. Bite registration was determined digitally using intra-oral scans with the laboratory caps applied over implant abutments.

Virtual wax patterns created for the definitive prostheses using the Cad system (DentalCad; Exocad, Boston, MA, USA; Figs. 15A and 15B) showed insufficient restorative space at the 16 implant site (Fig. 16). A new single implant level impression of this region was obtained using polyether (Impregum Penta Soft Medium Body; 3M ESPE, Minnesota, USA) to avoid food impaction caused by a large inter-dental space. The Acuris abutment was replaced with a cement-retained abutment (Ankylos Regular C/ø15°/GH 0.75 mm abutment; Figs. 17A and 17B). Definitive monolithic zirconia prostheses were milled according to the virtual designs and adjusted on the laboratory caps (Fig. 18). After occlusion and passive fit check from laboratory caps, they were removed from the abutment and changed into final caps on the abutment analogs. The final caps were tapped slightly into the abutments before final zirconia crowns for 14, 22, 26, and 36 were

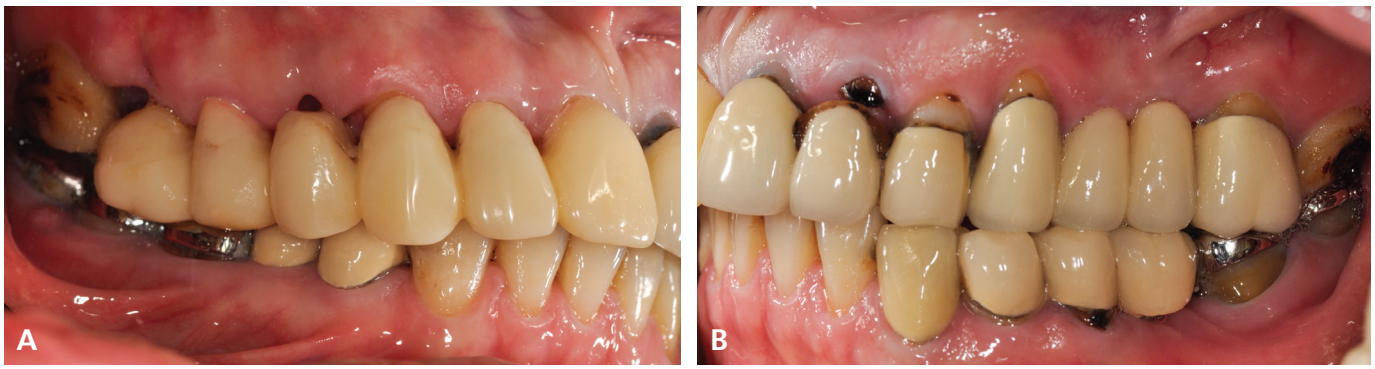


Figure 1. Intraoral view of the old prosthesis. (A) Right side. (B) Left side.

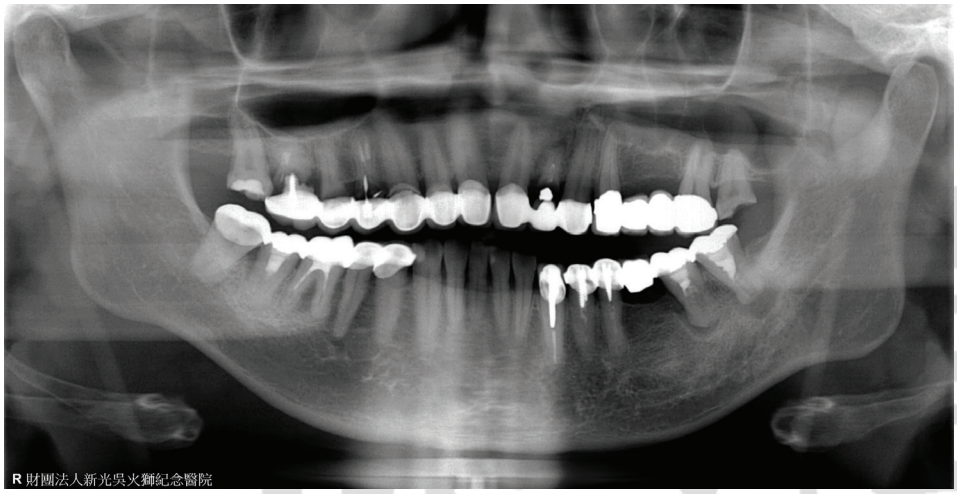


Figure 2. Panoramic film of the original status.

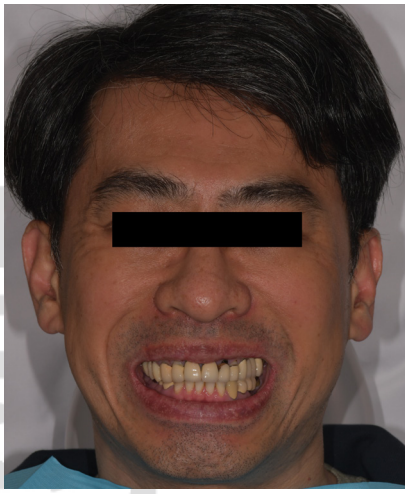


Figure 3. Initial frontal view of the patient.

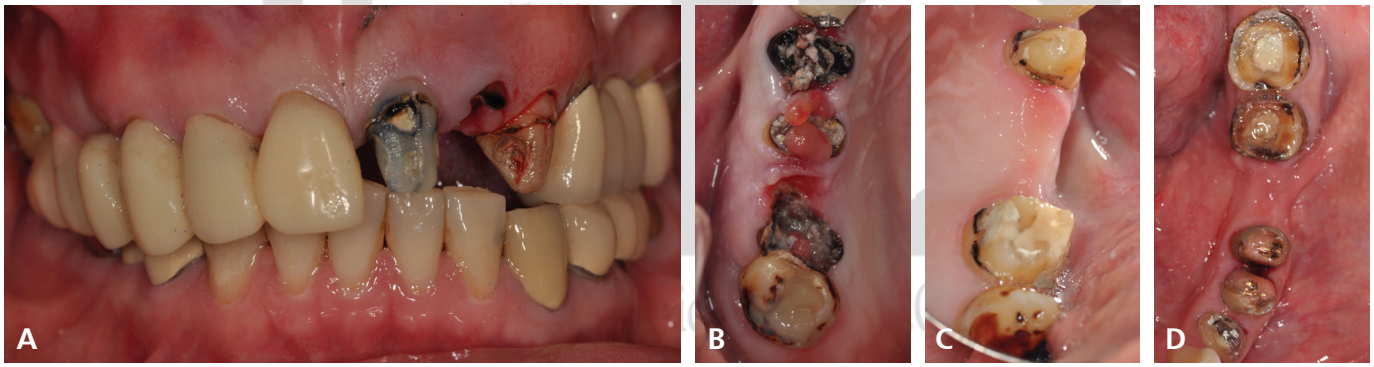


Figure 4. Abutment teeth status following old prosthesis removal. (A) Frontal view. (B) Upper right quadrant. (C) Upper left quadrant. (D) Lower left quadrant.

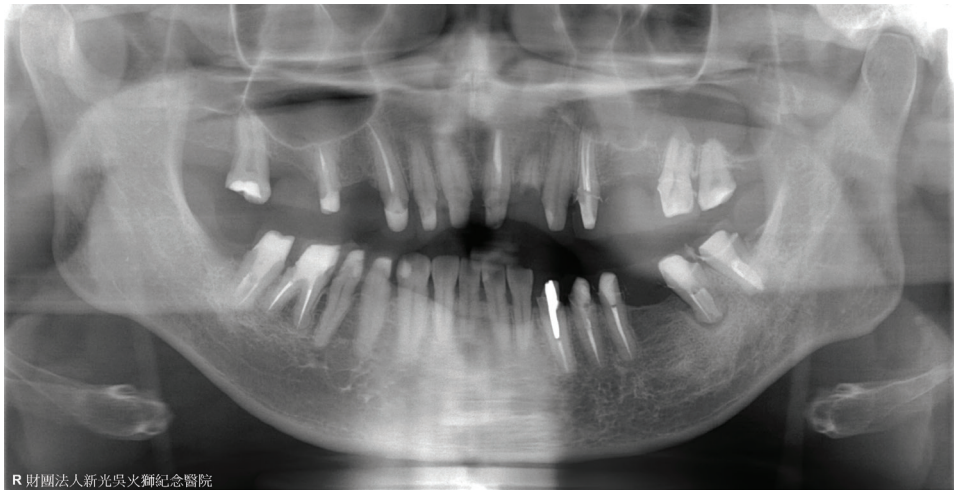


Figure 5. Panoramic film after disease control.

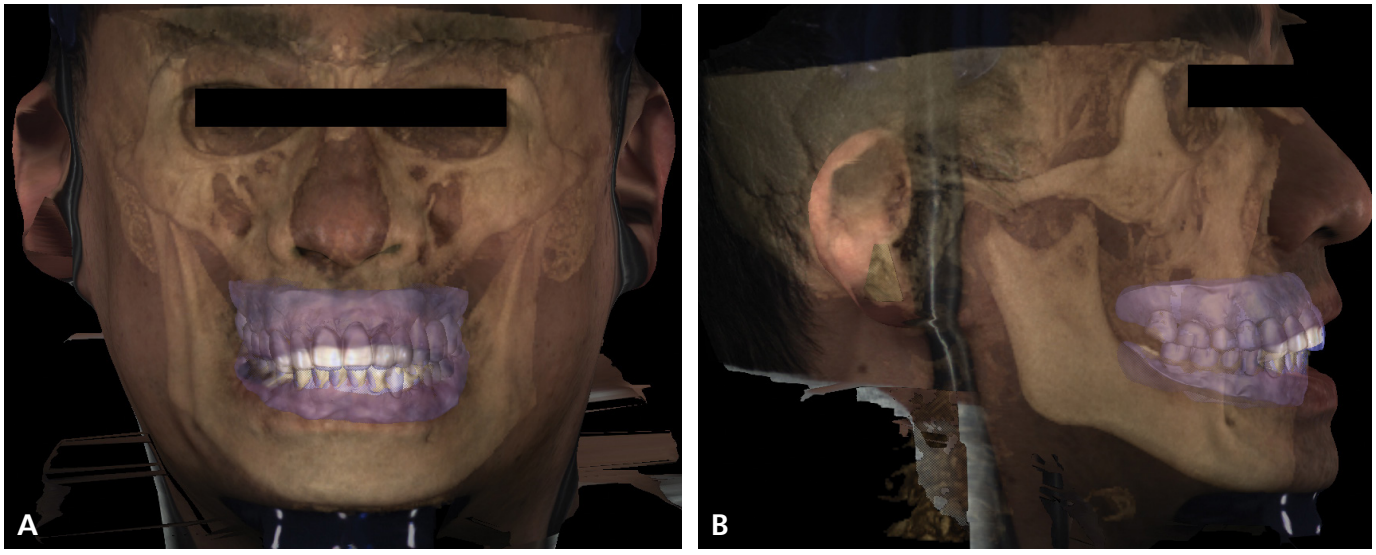


Figure 6. Provisional prosthesis design with facial scan and CBCT along the bony and soft tissue landmarks. (A) Frontal view. (B) Lateral view.

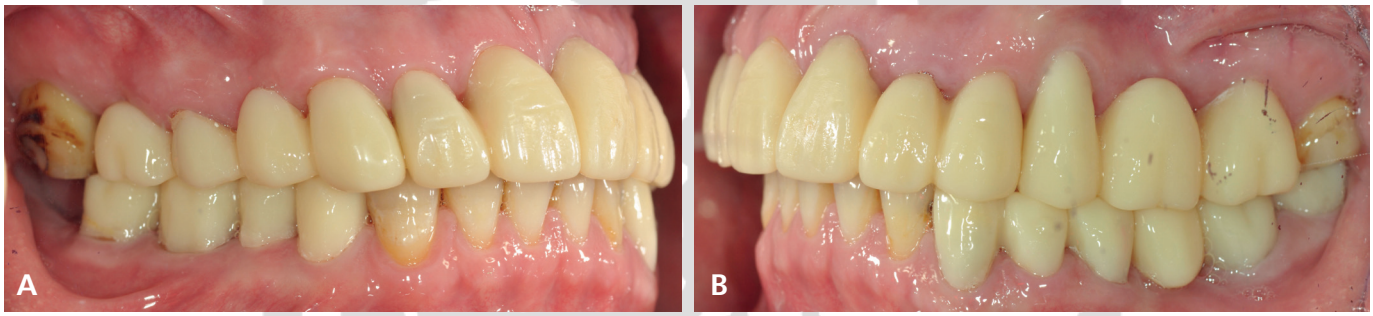


Figure 7. Delivery of the CAD/CAM PMMA provisional prosthesis. (A) Right side. (B) Left side.

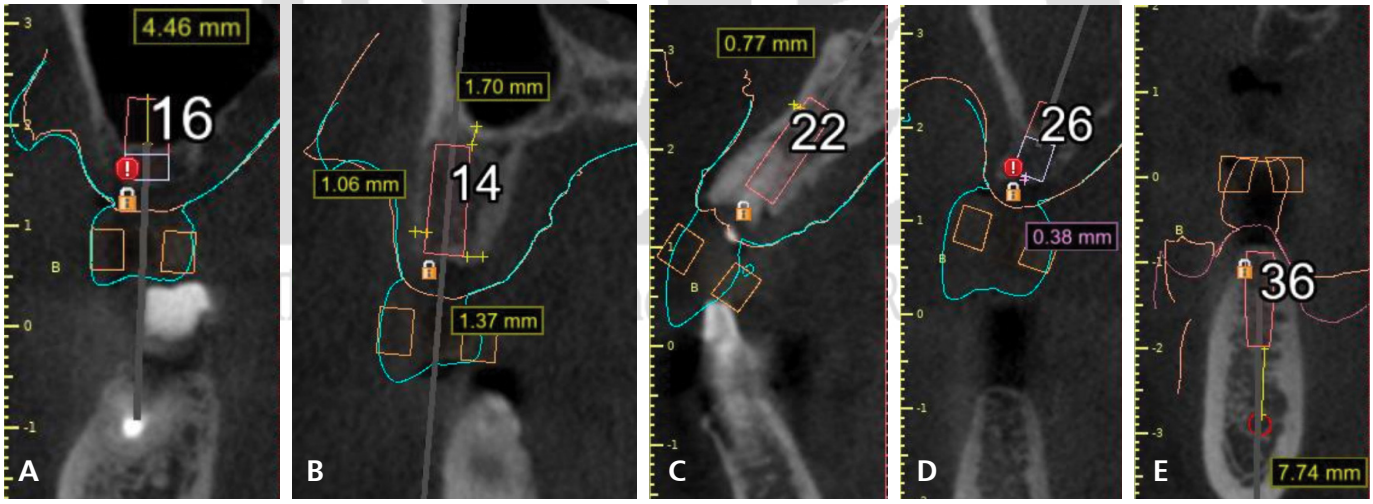


Figure 8. CBCT images analysis of the implant sites bone condition. (A) 16. (B) 14. (C) 22. (D) 26. (E) 36.

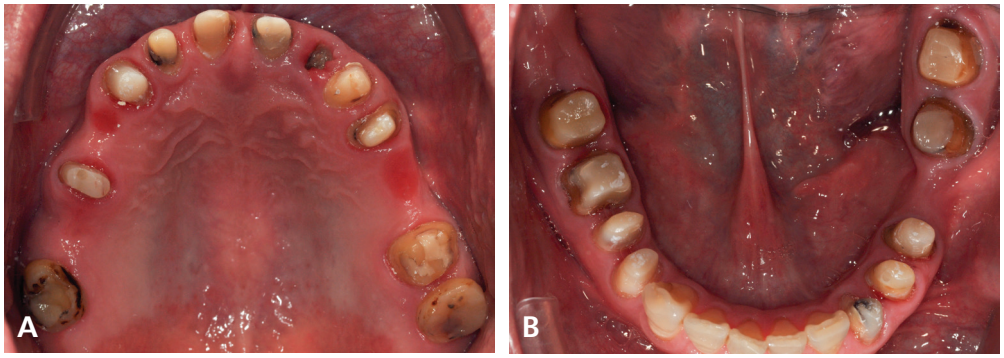


Figure 9. Intra-oral view of the abutment teeth and residual ridge after disease control. (A) Maxillae. (B) Mandible.

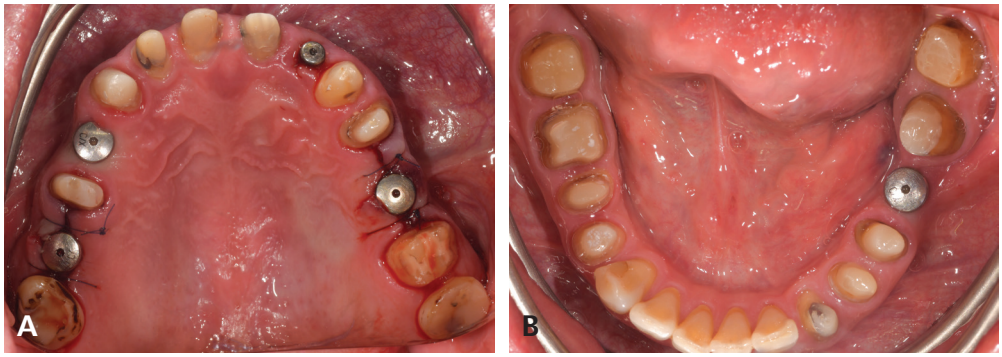


Figure 10. Intraoral view following implant placement. (A) Maxillae. (B) Mandible

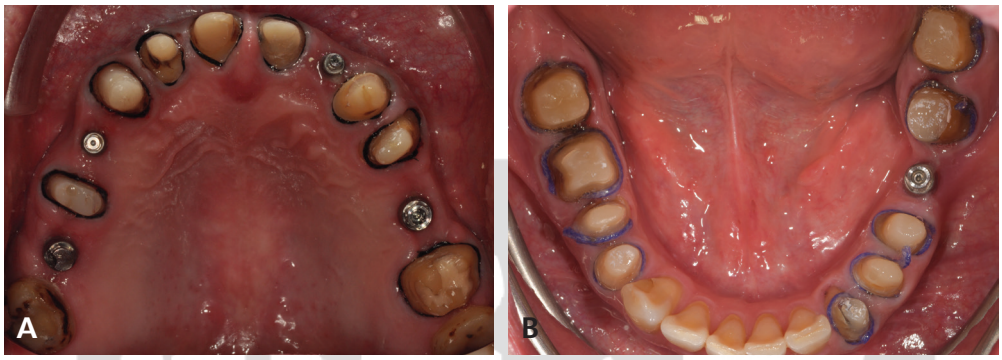


Figure 11. Acuris abutments were chosen and delivered. (A) Maxillae. (B) Mandible.

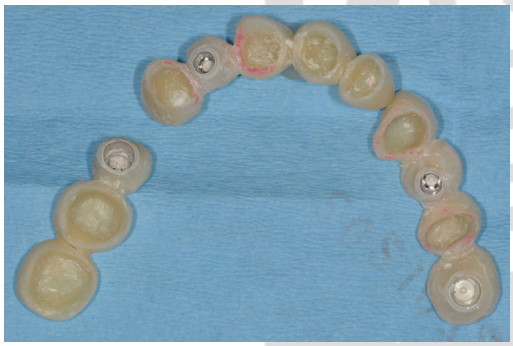


Figure 12. The temporization caps were removed , and provisional crowns were relined and reinstalled for early implant loading. A flowable resin was added for a proper emergence profile.

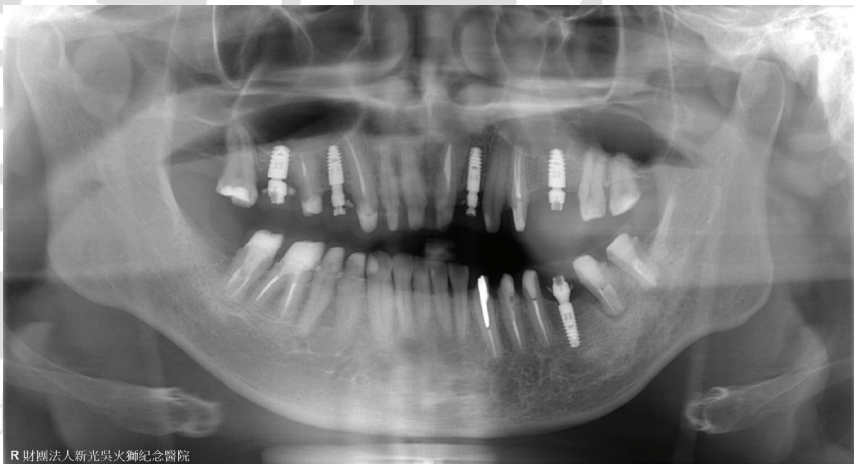


Figure 13. Panoramic film was used to check the fit of the abutments and the emergence profile.

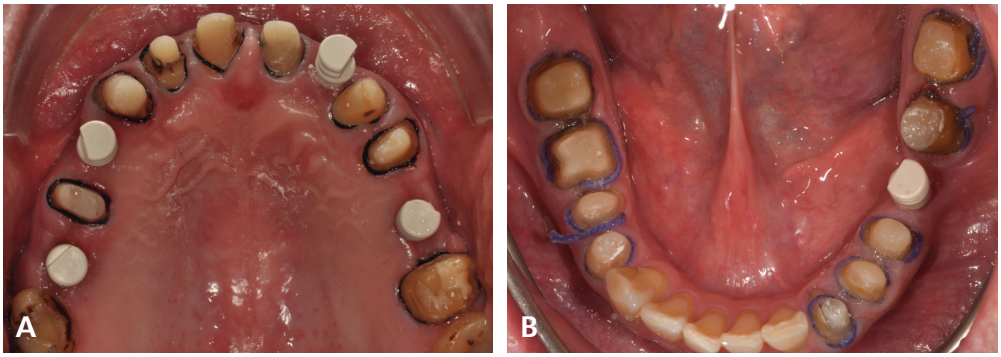


Figure 14. Impression caps try-in. The single cord gingival retraction technique and polyether were used for close tray impressions. (A) Maxillae. (B) Mandible.

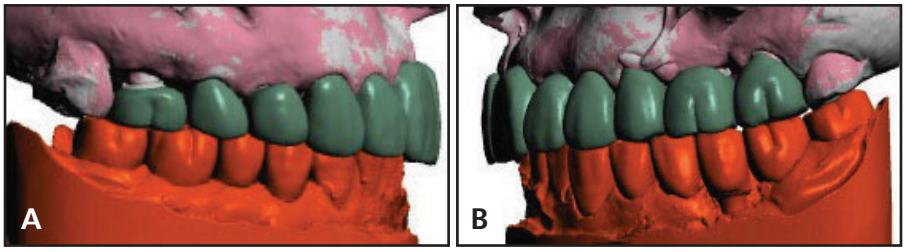


Figure 15. Creation of virtual wax patterns for the definitive prostheses on the lab caps using the Cad system (Exo-Cad).

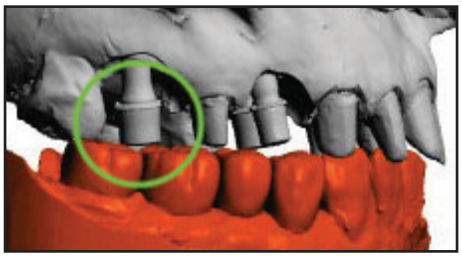


Figure 16. Insufficient restorative space at the #16 implant site. A large inter-dental space will cause food impaction.

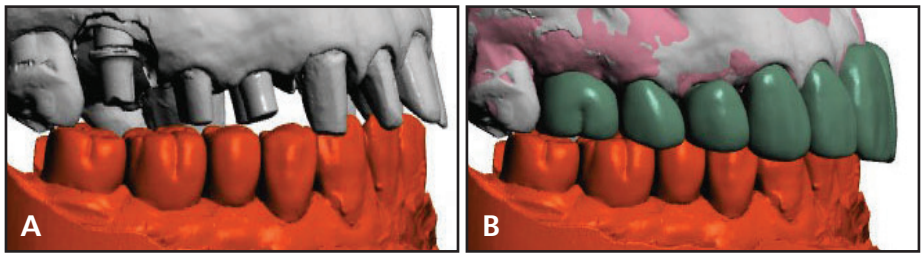


Figure 17. The Acuris abutment was replaced with a cement-retained abutment at the #16 implant site. (A) Abutment level. (B) Virtual wax of the definitive prostheses.

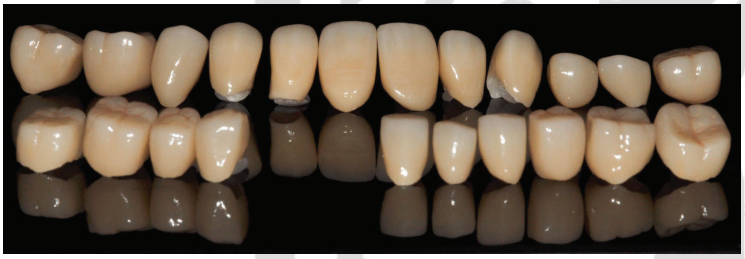


Figure 18. Definitive monolithic zirconia prostheses were milled according to the virtual designs.

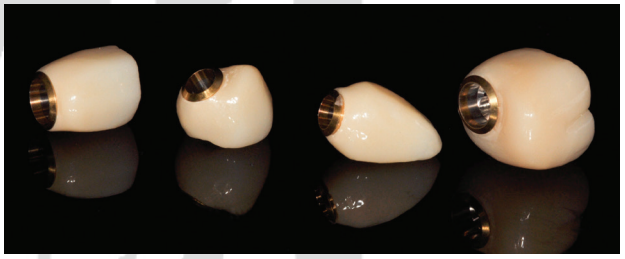


Figure 19. The final caps were tapped slightly into the abutments then the final zirconia crowns for #14, #22, #26, and #36 were cemented onto the final caps using resin cement (RelyX U200, 3M ESPE) on the lab model.

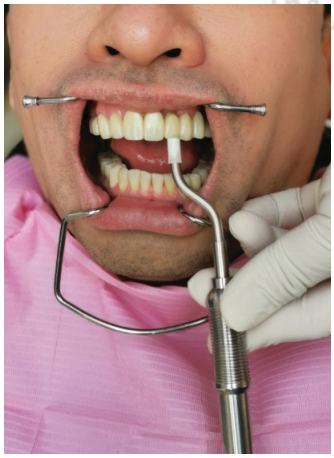
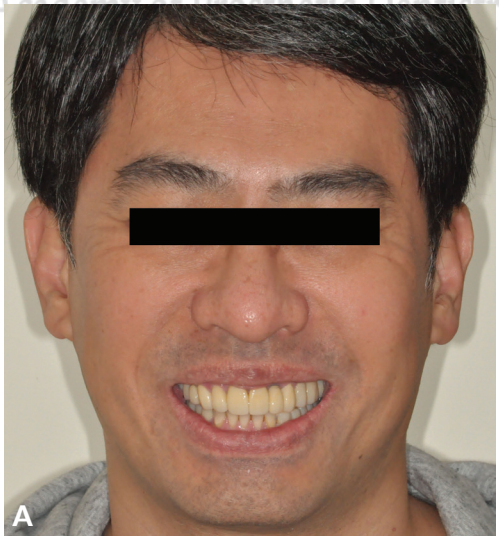


Figure 20.
The conometric crowns for #14, #22, #26, and #36 were delivered by the fixation tool.



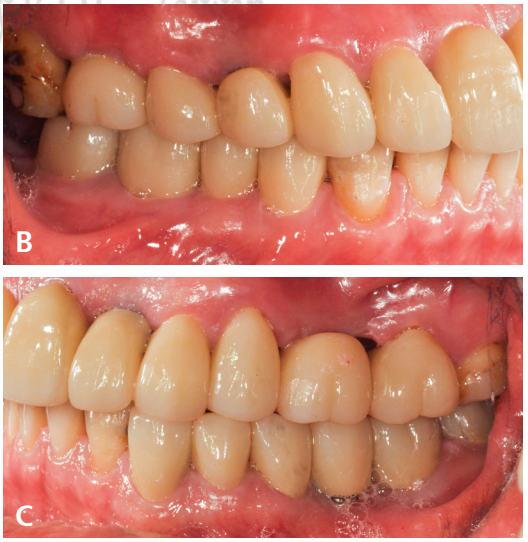


Figure 21. Definitive prosthesis delivery. (A) Fontal view. (B) Intra-oral view of the right side. (C) Intra-oral view of the left side.

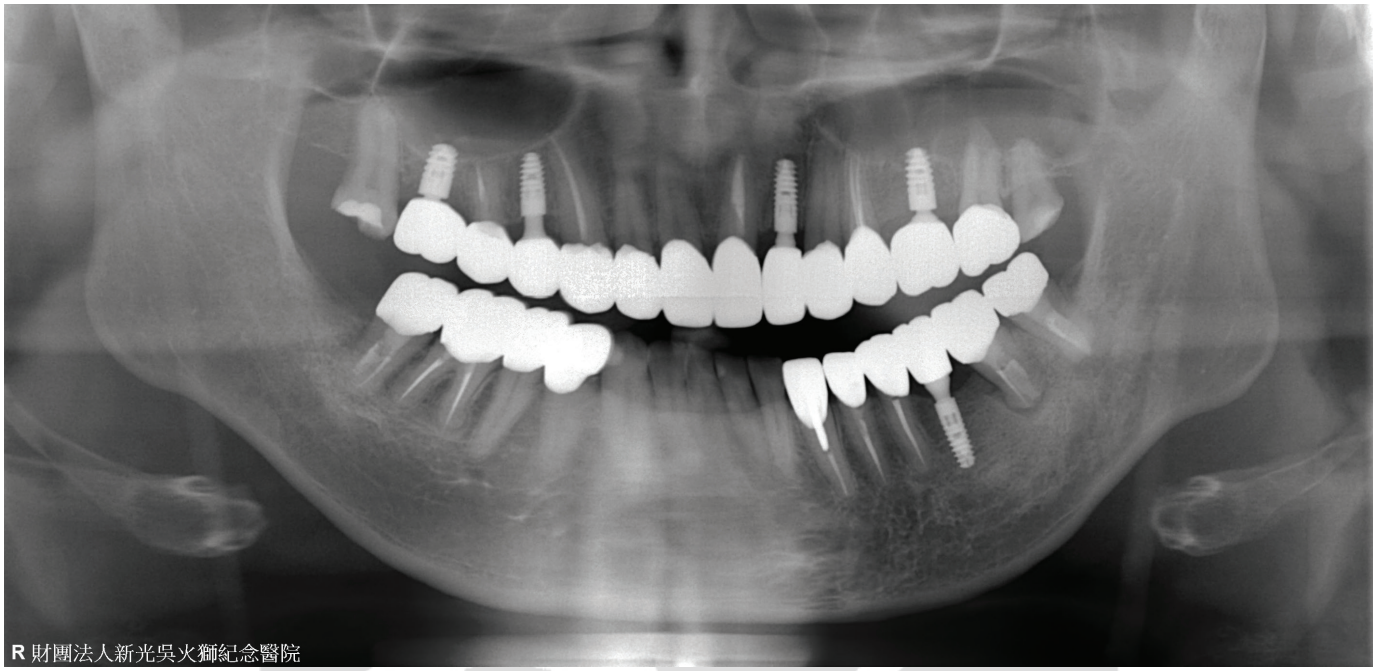


Figure 22. Confirmatory panoramic film following definitive prosthesis delivery.

cemented onto the final caps using resin cement (RelyX U200; 3M ESPE, Minnesota, USA ; Fig. 19) based on the lab model.

After confirmation of each new crown's occlusion and contact, the regular cement-type abutment of 16 was changed clinically using an extraoral cementation technique. The definitive prostheses for 11, 12, 13, 15, 21, 23, 24, 26, 27, 33, 34, 35, 37, 38, 44, 45, 46, and 47 were fixed using resin cement (RelyX U200; 3M ESPE, Minnesota, USA). The fixation tool delivered the conometric crowns for 14, 22, 26, and 36 in only one punch (Fig. 20). A combination of pressure and impulse was used to activate the retention between the Cap/Final crowns and abutments. The prosthesis fit and the precision and achievement of ideal esthetic outcomes were confirmed clinically (Figs. 21A-21C) and radiographically using new panoramic and periapical radiographs (Fig. 22).

Discussion

The conometric concept comprises a cemented tapered coping with a final crown inserted into a tapered abutment. Upon application of an insertion force and activation of the system, the coping's cervical margin is slightly deformed by the wedge effect, and elastic stress fields are created within the coping and abutment. These stresses will partially remain after the removal of the insertion force, providing a retentive capability to the system.[5]

A previous finite element analysis study reported that non-cemented conometric systems showed a range of retentive characteristics depending on the insertion load.[3] Under healthy conditions, mean maximum bite force values of 446 to 1221 N cause retentive forces >150 N, which are greater than the values observed in cemented systems, preventing dislodgment of the prosthetic devices during physiological function.[6] Similar results were also reported by Nardi et al.,[7] who showed that the welding caps' retention strength increased with higher abutment diameters and head heights and was comparable or superior to the values reported for temporary cements used in implant dentistry.

While traditional screw-retained prostheses offer tight retention, they are often associated with more common mechanical complications such as screw loosening and ceramic fractures. Tebbel et al. reported that the conometric connection of the tested samples maintained its stability over time under cyclic loading, and no wear effect was detected.[8] Moreover, another study by Tebble et al. concluded that the conometric mode of retention could withstand lateral forces thought to occur mainly in the anterior incisors region.[9]

The conometric concept is a paradigm shift in prosthetic retention of single crowns that are fixed but retrievable by the clinician. A previous study showed that the removal force increases with increasing pre-load but plateaus at higher loads (400–600 N).[10] This observation supports the assumption that even at higher forces, the retention of the conometric caps is manageable, maintaining the retrievability of the prostheses on the implants.

Using the conometric concept as a fixed connection between the implant and the prosthesis without cement can provide certain biological advantages, such as the decreased risk of compromising peri-implant soft tissues with excess luting agent compared to cemented and screw-retained treatments, resulting in optimal plaque control and frequent peri-implant soft tissue checks. An in vitro study showed that the Acuris conometric interface did not allow bacterial translocation under non-dynamic loading conditions.[11] While the luting gap between the prefabricated TiN-caps and the ceramic crown was within the clinically acceptable range, no microgap could be detected at the cone-in-cone Acuris junction by scanning electron microscopy analysis.

The results of this case report show good clinical feasibility for using the conometric concept on the abutments of immediate implants, providing a clinical cement-free mode of fixed retention, yet retrievable by the clinician. There is no screw hole and fillings on the zirconia crowns. A time-saving and easy-to-use solution for single crowns provides a simplified restorative concept to reduce chair time. Further studies are needed to analyze the long-term success rates of this clinical approach.

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Case Report

Implant-assisted removable prosthetic rehabilitation after maxillary segmental resection in a patient with ameloblastoma: a clinical report

Wu-Ping Chiu, DDS
Division of Prosthodontics, Department of Dentistry, Chi Mei Medical Center, Tainan, Taiwan

Yu-Fen Huang, DDS
Division of Prosthodontics, Department of Dentistry, Chi Mei Medical Center, Liouying, Tainan, Taiwan

Wei-Fan Chiang, DDS, MS
Department of Oral & Maxillofacial Surgery, Chi Mei Medical Center, Liouying, Tainan, Taiwan

Corresponding author:
Yu-Fen Huang
Department of Dentistry, Chi Mei Medical Center, Liouying, No.201, Taikang Vil., Liuying Dist., Tainan City 73657, Taiwan (R.O.C.)
Tel : +886-6-6226999
E-mail: sheenn19@hotmail.com

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Abstract

The Kennedy Class I and II distal extension removable partial dentures (RPDs) present a challenge to the prosthodontist since they require support from the underlying alveolar ridges' teeth and mucosa. This difference in compressibility between the periodontal ligaments of natural teeth and the alveolar mucosa also results in the RPD's rotation around a horizontal axis extending between the terminal abutments' distal rests, destabilizing the prosthesis. Distal placement of dental implants in the edentulous regions converts Kennedy Class I or II configuration to a Kennedy Class III situation, improves the prosthesis's stability, and enhances patient satisfaction. This case report describes using this approach to restore a Kennedy Class II partially edentulous situation after segmental resection of the maxillary arch due to ameloblastoma.

Key words: dental implant; distal extension removable partial denture; ameloblastoma.

Introduction

Ameloblastoma is an uncommon tumor of the oral and maxillofacial region that occurs most often in the mandible and less commonly in the maxilla[1]. It is histologically benign but locally invasive. It has reported recurrence rates as high as 92% with conservative treatment[2] and 15%–25% with radical treatment[3-4]. Therefore, wide resection of the jaw is typically recommended to prevent recurrence.

Wide resection results in an unfavorable soft tissue profile for retention, reduced stability for prostheses supported by soft tissue, and a loss of load-bearing tissues available for support. These outcomes may pose challenges to restoring normal speech, masticatory ability, and quality of life.

Implant-supported fixed dental prostheses have successfully been used to restore masticatory function[5]. However, anatomic limitations (e.g., proximity to the vital organ, poor bone quality, and lack of bone volume) and financial constraints may preclude sufficient implants from supporting a fixed dental prosthesis. In such situations, the removable partial denture (RPD) is indispensable for patients.

However, the inadequacy of hard and soft tissue at the wide resection site may compromise the RPD's retention, stability,

and support and worsen its distal extension[6]. To overcome this challenge, placing the implant on the distal edentulous ridge effectively converts Kennedy Class I to Kennedy Class III. Therefore, the implant can improve the ridge's support, minimize the potential for the denture 's dislodgement, and maintain the residual alveolar bone[7].

This clinical report describes the treatment planning and restoration procedure of implant-assisted RPD in maxillary rehabilitation after segmental resection.

Case report

A 55-year-old man had undergone segmental resection of the left maxilla due to follicular ameloblastoma in the Department of Oral & Maxilla-facial Surgery, Chi-Mei Medical Center (Liouying, Taiwan). The patient's chief complaint was an unaesthetic appearance and difficulty chewing due to multiple missing teeth. His medical history revealed no major systemic problems except follicular ameloblastoma in the left maxilla.

Clinical examination showed an asymmetrical face due to insufficient lip support. Intraoral examination showed multiple missing teeth, including the upper left central incisor, lateral incisor, canine, first premolar, second premolar, and first molar ; insufficient keratinized tissue; reduced vestibular sulcus depth; fibrous scar tissue; and compromised soft tissue contour in the area to be reconstructed (Fig. 1). After radiographic examination, the maxillary left second molar was to be extracted due to poor periodontal support (Fig. 2). The antagonistic arch was relatively sound. The patient was unaware of parafunctional activity, such as grinding or clenching. Three treatment options were presented: unilateral implant-supported fixed partial denture, implant-assisted RPD, and conventional RPD. The patient chose the second option due to financial limitations, fewer surgical procedures, and better denture stability.

Initially, maxillary and mandibular impressions were taken with regular set alginate (Cavex, Netherlands) and poured with dental stone (Neo Primestone; Mutsumi Chemical, Japan) to obtain

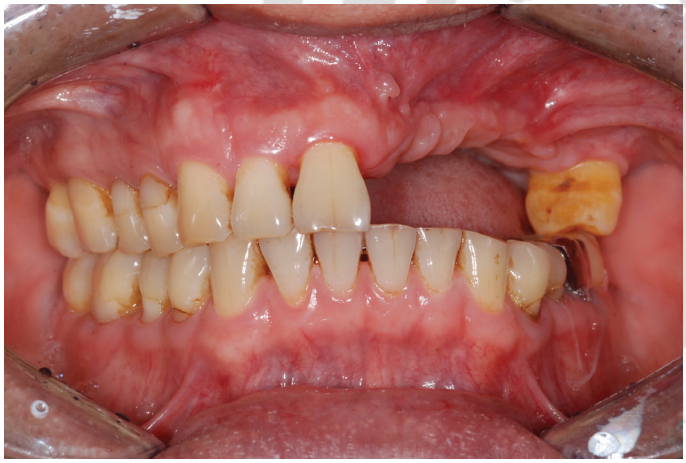

Figure 1. Frontal view of the patient's dentition.

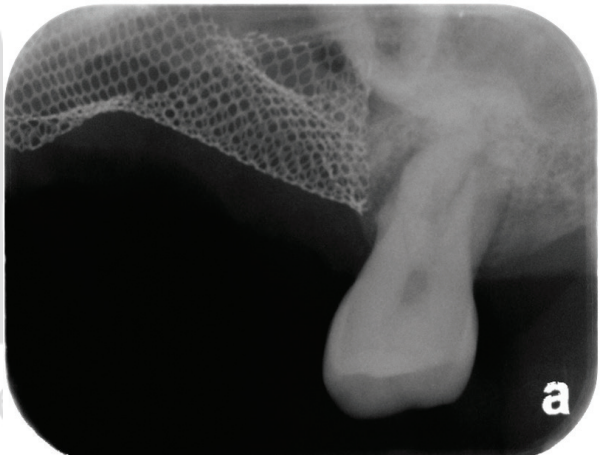

Figure 2. Periapical film of the maxillary left second molar.

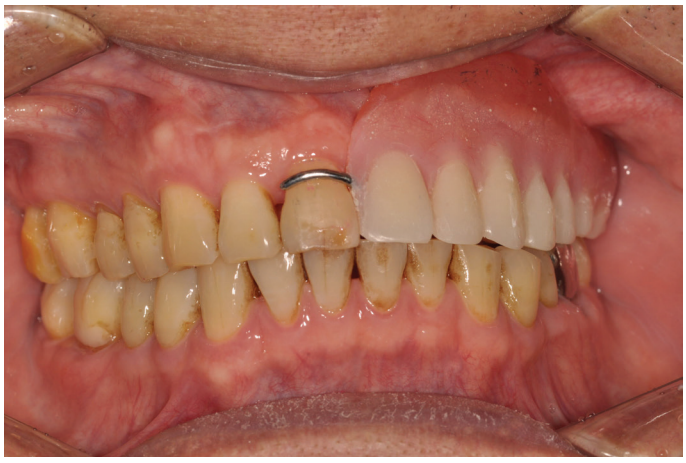

Figure 3. Frontal view of the interim denture insertion.

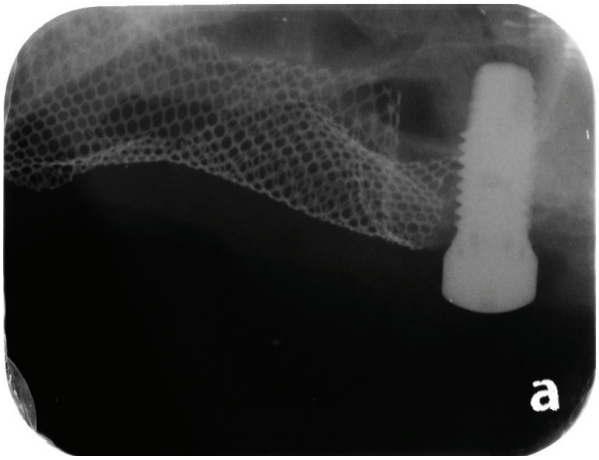

Figure 4. Periapical film of the implant with healing abutment.

study casts. The maxillary cast was surveyed for implant-assisted RPD to determine the favorable insertion path for the RPD and implant. An interim denture fabricated from the diagnostic wax-up with tissue surface relined with Soft Liner (GC Soft Liner ; GC, Japan) was provided to the patient (Fig. 3).

An implant-assisted RPD was planned. A cone-beam computerized tomography scan was performed with a radiographic guide, duplicated from the interim denture, to determine the implants' dimensions and locations.

One Brånemark System Mk III TiUnite implant (5.0 × 11.5 mm; Nobel Biocare, Sweden) was placed in the maxillary right second molar area with a submerged surgical procedure. The patient's maxillary interim RPD was relined with Soft Liner after sufficient room had been created between the wound and the denture's intaglio surface. The patient used the modified RPD during the osseointegration period. After the implant's six-month osseointegration, stage II surgery was performed to uncover the implant, and healing abutments were placed (Fig. 4).

Following four weeks of soft tissue healing (Fig. 5), a border molding of the maxillary left side was made with green compound (Impression Compound ; Kerr, Czech Republic), and a fixture-level impression was made with polyether impression material (Impregum; 3M ESPE). Dental stone (Neo Primestone; Mutsumi Chemical, Japan) was poured to create the definitive maxillary cast. The definitive casts were surveyed to confirm tooth preparation accuracy. Permanent abutments (Locator ; Zest Anchors, USA) were placed on the implant analogs and relieved with wax to provide room for RPD's metal framework. Wax patterns of the RPD's framework were fabricated according to the design. Following casting, finishing, and polishing procedures, the metal framework's fit was confirmed intraorally. After the occlusion rim had been tested on the framework, jaw relation records were made, then both maxillary and mandibular casts were mounted on an articulator. Artificial teeth (Orthotype; Ivoclar, Lichtenstein) were arranged, and heat-curing acrylic resin (Lucitone 199; Dentsply) was packed in the laboratory.

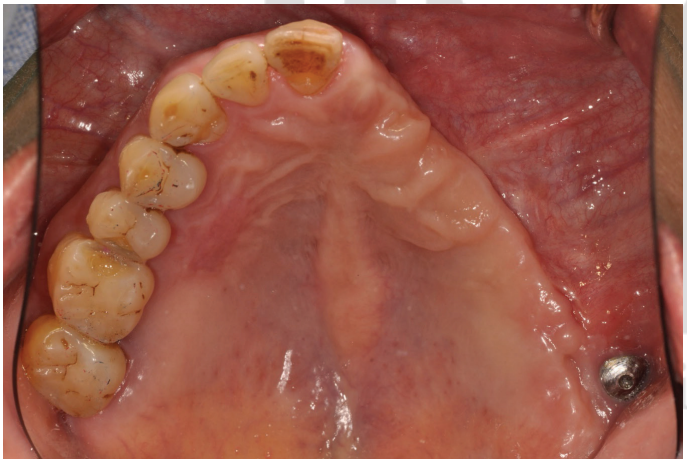

Figure 5. Occlusal view of the maxilla before final impression.

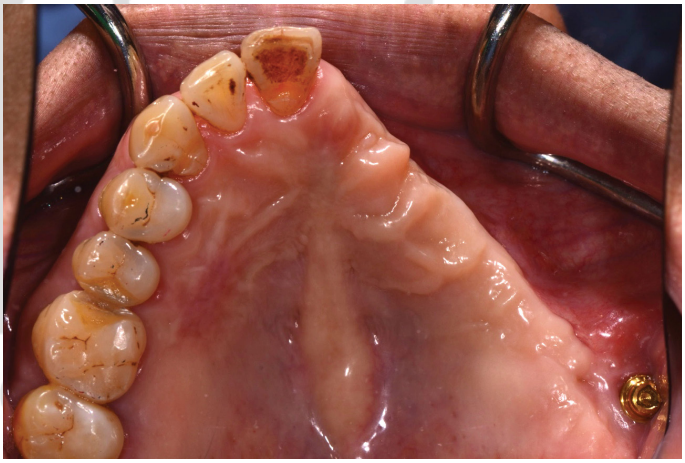

Figure 6. Occlusal view of the locator attachment.

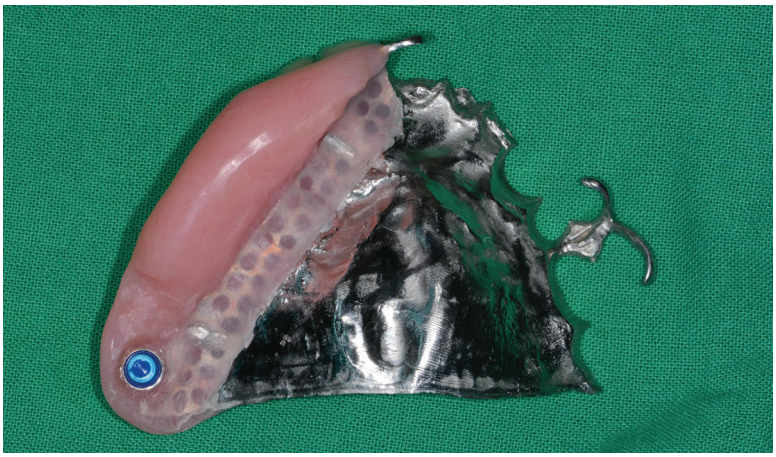

Figure 7. After picking up the metal housing and changing the blue nylon on the removable partial denture's tissue surface of the removable partial denture. insertion.

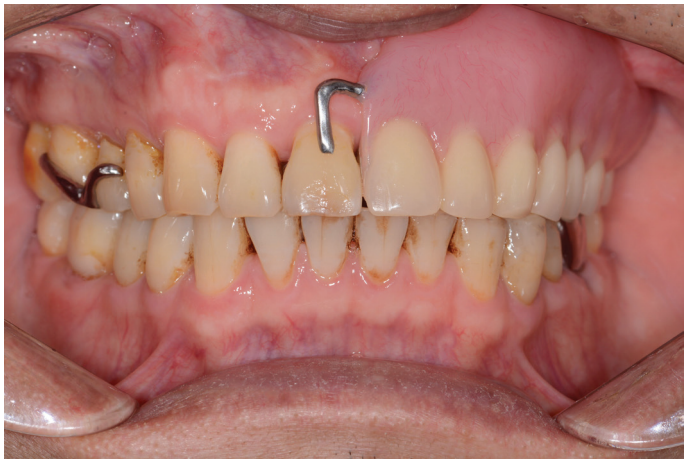

Figure 8. Frontal view of the implant-assisted removable partial denture.

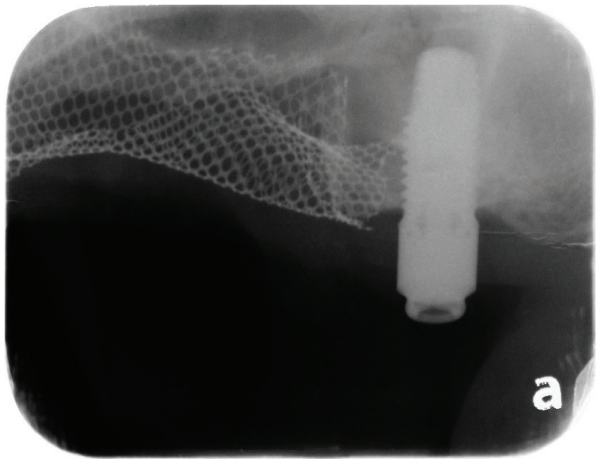

Figure 9. Periapical film of the implant at the three3-year follow- up.

The passive fit between the abutments and the RPD was evaluated intraorally. The healing abutment was removed, and the Locator was connected to the fixture with the tightening torques recommended by the manufacturers. After sufficient room space had been established between the Locator and the denture's interior acrylic surface, the definitive maxillary RPD was relined with acrylic resin (Rebase II; Tokuyama, Japan) to reflect the locator's patrix. After polishing and changing the processing clip to blue, the denture was delivered to the patient with proper home care instructions (Figs. 6, 7, and 8).

Following postinsertion appointments, the patient was recalled for tissue examination and appliance modification after one, three, and then every six months. The last follow-up was a three-year recall. The plastic retentive parts had become worn and were replaced with clear ones. Nevertheless, the implant's bone level was stable (Fig. 9), and the patient was satisfied with the denture 's retention, masticatory efficiency, and aesthetics.

Discussion

Because of ameloblastoma's high recurrence rate and local invasiveness, they are usually treated with wide resection. However, radical resection resulting in soft and hard tissue defects poses challenges to prosthetic rehabilitation with implant-supported fixed dental prostheses. When planning fixed-type prostheses in these patients, resected regions might need further augmentation surgery, such as sinus floor elevation and vertical and/or horizontal ridge augmentation. Due to the additional surgical procedure's complexity and concern about tumor recurrence, implant-assisted RPDs can be an alternative treatment.

The design and maintenance of bilateral and unilateral distal extension partial dentures pose challenges for clinicians due to the lack of an abutment tooth distal to the edentulous area to provide support and the difference in the displacement of the mucosa and the natural tooth under function[8]. Moreover, this is progressively challenging when poor peripheral soft tissue elasticity and reduced sulcus depth occur due to surgery since they might lead to greater denture instability, frequent adjustment, and decreased patient satisfaction.

Strategic placement of implants under the existing dental prostheses improves oral health-related quality of life in RPD treatment groups[9]. Previous studies have indicated that an implant placed posteriorly to the RPD's distal extension site reduces pressure on the alveolar ridge[10,11], maintains the residual alveolar ridge's height[12], reduces potential rotational movement[13], and results in better prosthesis stability and less frequent prosthetic maintenance visits.

Placing a single implant in the posterior region to change a Kennedy Class I or II arch configuration to Kennedy Class III appears to be a favorable treatment. Theoretically, the implants should be placed as distally as possible to provide maximal support and stability. However, pronounced anatomic limitations, such as proximity to the inferior alveolar nerve or maxillary sinus or insufficient bone volume, can restrict implant placement. Short dental implants may be selected for patients contraindicated for the advanced surgical procedure to improve distal extension RPD performance[14].

There is insufficient evidence on the relative

effectiveness of different attachment systems on the clinical outcomes of implant-assisted RPDs[15]. In this case, a Locator attachment was selected because it has a lower vertical height, a minimal interocclusal distance requirement, fewer prosthodontic complications, lower maintenance needs[16], higher retention and stability[17], and is easier to use with fewer reported complications than ball and bar attachments[18].

Summary

Implant-assisted RPDs are a cost-effective solution for partially edentulous patients who are not candidates for fixed implant-supported restorations and need to use distal extension RPDs. This case report described a segmental resected maxillary arch reconstructed with a single implant with a Locator abutment and a chromium-cobalt RPD. A freestanding, distal single implant aids support and retention and prevents dislodgement of the patient's distal extension RPD.

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Journal of Prosthodontics and Implantology

Introduction for authors

Types of article

All works related to basic or clinical prosthodontics, temporomandibular joints or masticatory function, dental implants, and technical science of dental prosthodontics are the objects of publication. There are five types of accepted manuscripts, please indicate the type of manuscript.

- Review article
- Original article
- Technical report
- Case report
- Letters to the Editor

General Format guide

- Articles must not have been published or will be accepted for publication in other journals.
- Please write your text in good English (American or British usage is accepted, but not a mixture of these) , and the content of the article is typed in double spacing, with font size 12 and above, with at least 2.5 cm margin on each side, and without any formatting.
- The total number of pages of the full text (including abstract, figures, tables, and references) is limited to eight pages, and can be extended to twelve pages if necessary.
- Please use electronic documents to submit manuscripts. IBM-Microsoft Word is recommended as the word processing program. The program used, the title of the manuscript, and the name of the first author must be marked. The electronic file should be emailed to: prosthor@ms48.hinet.net.
- Please also include a short letter to the Editor-in-Chief of the Journal stating that you would like to contribute to the Journal and stating that all authors have read and signed the consent form. If the research involves the use of human subjects, the manuscript must be accompanied by the consent of the appropriate institutional review board or ethics committee.

Review Articles Format Guide

These should aim to provide the reader with a balanced overview of an important and topical issue in prosthodontic field. They should cover aspects of a topic in which scientific consensus exists as well as aspects that remain controversial and are the subject of ongoing scientific research. All articles or data sources should be selected systematically for inclusion in the review and critically evaluated.

- Abstract: required, up to 400 words, unstructured (i.e., no subheadings)
- Keywords: up to 10
- Word limit: 3500 words
- References: up to 100
- Tables/Figures: 1 maximum

Original Articles Format Guide

Section headings should be: Abstract, Introduction, Materials and methods, Results, Discussion, Conclusion Conflicts of Interest Statement, Acknowledgments (if any), and References.

(1) ***The Introduction*** should provide a brief background to the subject of the paper, explain the importance of the study, and state a precise study question or purpose.

(2) ***The Materials and methods*** section should describe the study design and methods (including the study setting and dates, patients/participants with inclusion and exclusion criteria, patient samples or animal specimens used, the essential features of any interventions, the main outcome measures, the laboratory methods followed, or data sources and how these were selected for the study), and state the statistical procedures employed in the research.

(3) ***The Results*** section should comprise the study results presented in a logical sequence, supplemented by tables and/or figures. Take care that the text does not repeat data that are presented in tables and/or figures. Only emphasize and summarize the essential features of the main outcome measures, and the main results.

(4) ***The Discussion*** section should be used to emphasize the new and important aspects of the study, placing the results in context with published literature, the implications of the findings.

(5) The conclusion that follows from the study results.

- Abstract: required, up to 400 words
- Keywords: up to 10
- Word limit: 3000 words
- References: up to 40

Technique Reports/ Case Reports Format Guide

These are short discussions of a case / case series/ technique report with unique features not previously described that make an important teaching point or scientific observation. They may describe novel techniques or use of equipment, or new information on diseases of importance. Section headings should be: Abstract, Introduction, Case Report, Discussion, Conflicts of Interest Statement (if any), Acknowledgments (if any), and References.

Case reports should have no more than 6 authors. The maximum length is 2000 words, and the number of references should not exceed 10.

Letters to the Editor Format Guide

Brief letters of constructive comments in response to previously published JDS articles are welcome. Ensure that the corresponding author's mailing and e-mail addresses are included. Letters are edited, sometimes extensively, to sharpen their focus. They may be sent for peer review at the discretion of JDS Editors. Letters are selected based on clarity, significance, and space.

- Author: up to 3
- Word limit: 250 words
- Tables/Figures: 1 maximum

Manuscript Preparation

Text should be typed double-spaced on one side of white A4 (297 × 210 mm) paper, with outer margins of 2.5 cm. A manuscript should include a title page, abstract, text, references, conflicts of interest statement (if any), acknowledgments (if any), and figures and tables as appropriate. Each section of the manuscript should begin on a new page. Pages should be numbered consecutively, beginning with the title page.

The detailed specifications of the manuscript content are as follows:

➢ ***Title page***

The title page should contain the following information (in order, from the top to bottom of the page): article category article title names (spelled out in full) of all authors*, and the institutions with which they are affiliated†; indicate all affiliations with a superscripted lowercase letter after the author's name and in front of the matching affiliation corresponding author details (name, e-mail, mailing address, telephone and fax numbers). A running title must be within 40 characters. Please provide the detailed information of the corresponding author (name and address in English, telephone and fax numbers, email address).

➢ ***Abstract and keywords***

An abstract (no longer than 400 words) and relevant keywords (limited to 5) are required.

(1) Abstracts for **Review Articles, Case Reports and Technique report** should be *unstructured (in one single paragraph with no section headings)*, and include information on the background/purpose of the report, methods, results (or case report), and conclusions.

(2) Abstracts for **Original Articles** should be structured into the following sections. **Aims:** briefly explain the importance of the study topic and state a precise study question or purpose. **Materials and Methods:** briefly introduce the methods used to perform the study; include information on the study design, setting, subjects, interventions, outcome measures and analyses as appropriate. **Results:** briefly present the significant results, with data and statistical details such as p values where appropriate; be sure that information in the abstract matches that in the main text. **Conclusion:** state the meaning of your findings, being careful to address the study question directly and to confine your conclusions to aspects covered in the abstract; give equal emphasis to positive and negative findings.

(3) Keywords should be taken from the Medical Subject Headings (MeSH) list of Index Medicus (http://www.nlm.nih.gov/mesh/meshhome.html).

➢ ***Main Text***

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- Introduction: Briefly explain the origin of the research.
- Materials and methods: Describe the research design, objects, and procedures.
- Results: The results are expressed in words, tables or illustrations.
- Discussion: Emphasize important results and arguments, and compare with previous studies.
- Conclusion: The conclusion should be concise and clear.
- Conflicts of interest statement
- Acknowledgments (if any)
- References

(3) **Technical report**

Sections for technical reports are Introduction, Methods, and Discussion, Conflicts of interest statement (if any), Acknowledgments (if any), and References. Each section should begin on a new page.

(4) **Case report**

Sections for case reports are Introduction, Case description, and Discussion, Conflicts of interest statement (if any), Acknowledgments (if any), and References. Each section should begin on a new page.

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Where a term/definition will be continually referred to, it must be written in full when it first appears in the text, followed by the subsequent abbreviation in parentheses. Thereafter, the abbreviation may be used. An abbreviation should not be first defined in any section heading; if an abbreviation has previously been defined in the text, then the abbreviation may be used in a subsequent section heading. Restrict the number of abbreviations to those that are absolutely necessary and ensure consistency of abbreviations throughout the article. Ensure that an abbreviation so defined does actually appear later in the text (excluding in figures/tables), otherwise, it should be deleted.

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Numbers that begin a sentence or those that are less than 10 should be spelled out using letters. Centuries and decades should be spelled out, e.g., the Eighties or nineteenth century. Laboratory parameters, time, temperature, length, area, mass, and volume should be expressed using digits.

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Système International (SI) units must be used, with the exception of blood pressure values which are to be reported in mmHg. Please use the metric system for the expression of length, area, mass, and volume. Temperatures are to be given in degrees Celsius.

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Use the Recommended International Nonproprietary Name (rINN) for medicinal substances, unless the specific trade name of a drug is directly relevant to the discussion. Generic drug names should appear in lowercase letters in the text. If a specific proprietary drug needs to be identified, the brand name may appear only once in the manuscript in parentheses following the generic name the first time the drug is mentioned in the text.

For devices and other products, the specific brand or trade name, the manufacturer and their location (city, state, country) should be provided the first time the device or product is mentioned in the text, for example, "¡KSPSS version 11 was used (SPSS Inc., Chicago, IL, USA)" ". Thereafter, the generic term (if appropriate) should be used.

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References should be limited to those cited in the text and listed in numerical order (superscript). Please refer to Cumulated Index Medicus for the writing format. References should include, in order, all authors' names, article title, journal name, year, volume and inclusive page numbers.

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References should include, in order, authors' surnames and initials, article title, abbreviated journal name, year, volume and inclusive page numbers. The surnames and initials of all the authors up to 6 should be included, but when authors number 7 or more, list the first 3 authors only followed by "et al".

Examples of the common reference types are provided below.

- **Standard journal articles:** Lin YT, Chang LC. Space changes after premature loss of the mandibular primary first molar: a longitudinal study. J Clin Pediatr Dent 1998; 22:311-6.
- **Book with edition:** McDonald RE, Avery DR. Dentistry for child and adolescent. 6th ed., Mosby Co., St. Louis, 1994; pp339-41.
- **Book chapter in book with editor and edition:** Moore BK, Avery DR. Dental materials. In: McDonald RE, Avery DR. Dentistry for child and adolescent. 6th ed., Mosby Co., St. Louis, 1994; pp349-72.
- **Electronic publications:** Yavuz MS, Aras MH, üyükkurt MC, Tozoglu S. Impacted mandibular canines. J Contemp Dent Pract 2007;8(7):78- 85. Available at: http://www.thejedp.com/issue036/index.htm. Accessed November 20, 2007.

➢ ***Figures and legends***

- Illustrations should not be included in the main text or edited, but should be stored in a separate folder. Image files should be archived in JPG, EPS or TIF format and submitted electronically via e-mail.
- The title and detailed description of the illustration must be typed double-spaced on a separate page. Photomicrographs should include an internal scale marker to indicate the magnification.
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- The number of figures should be restricted to the minimum necessary to support the textual material. Figures should have an informative figure legend and be numbered in the order of their citation in the text.
- All symbols and abbreviations should be defined in the figure legend in alphabetical order.

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The title and detailed description of each table must be typed double-spaced on separate pages, and numbered in Arabic numerals.

Tables should supplement, not duplicate, the text. They should have a concise table heading, be self-explanatory, and numbered consecutively in the order of their citation in the text. Items requiring explanatory footnotes should be denoted using superscripted lowercase letters (a, b, c, etc.), with the footnotes arranged under the table in alphabetical order. Asterisks (*, **) are used only to indicate the probability level of tests of significance. Abbreviations used in the table must be defined and placed after the footnotes in alphabetical order. If you include a block of data or table from another source, whether published or unpublished, you must acknowledge the original source.

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After the Conflicts of Interest Statement and/or Funding/Support Statement, general acknowledgments for consultations and statistical analyses should be listed concisely, including the names of the individuals who were directly involved. Consent should be obtained from those individuals before their names are listed in this section. Those acknowledged should not include secretarial, clerical or technical staff whose participation was limited to the performance of their normal duties.

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- A short letter to the Editor-in-Chief.
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- Keywords (limited to 5) and a running title within 40 characters.
- Confirm that the format, content, and order of citation of all references are complete and correct.
- Confirm titles and footnotes for all tables, and detailed titles and descriptions for figures. Type them double-spaced on separate pages.
- Verify that all tables and figures are formatted correctly. Tables and figures are stored in separate folders and not included in the main text.
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3. 技術報告（technical report）
4. 病例報告（case report）
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   - 前言（introduction）：簡要說明研究由來。
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   - 結果（results）：研究結果以文字、表格或插圖表示之。
   - 討論（discussion）：強調重要結果與論點，與前人論述作比較等。
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   (2) 書籍之書寫：

   McDonald RE, Avery DR. Dentistry for child and adolescent 6th ed., Mosby Co, St Louis, 1994; pp339-41.

   (3) 有編輯者之書籍章節書寫：

   Moore BK, Avery DR. Dental materials. In: McDonald RE, Avery DR. Dentistry for child and adolescent 6th ed., Mosby Co., St. Louis, 1994; pp349-72.

   (4) 電子期刊之書寫：

   Yavuz MS, Aras MH, üyükkurt MC, Tozoglu S. Impacted mandibular canines. J Contemp Dent Pract 2007; 8(7):78-85. Available at: http://www.thejedp.com/issue036/index.htm. Accessed November 20, 2007.

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