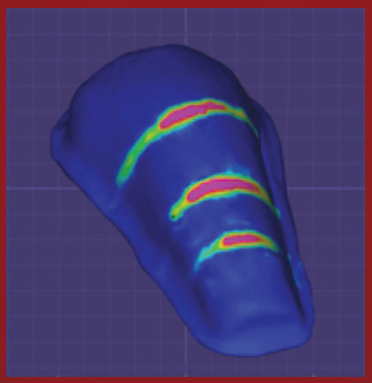
The Academy of Prosthetic Dentistry R.O.C., Taiwan

Journal of Prosthodontics and Implantology

Pictures of sample with three artificial cut in 3D CMM - labial view.



3D image superimposition before and after test of ZPC at crown, neck, and root.

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Journal of Prosthodontics and Implantology

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Journal of Prosthodontics and Implantology

Editorial

Experience has forged lessons of self-improvement, wisdom, and expectations for prosthodontists. Furthermore, strength in faith and determination has led to tremendous growth over 30 years.

As the founding member, it is my honor to serve as a committee member and dedicate myself to the Academy.

There are no short cuts to success. It is a direct result of preparation, hard work, and lessons learned from failure. A reflection of the past helps one to understand the present.

In this volume, we reflect on two original studies and two case studies.

Case reports serve to increase judgment through experience. In place of studies such, the experiences provide the basis to amass measures for further dental practices.

As the aforementioned articles are worth reading, it gives me great pleasure to share this issue with you. We are also pleased to share with you additional information of importance. As of March 2020, all JPI articles with registered DOI can now be found online at the Airiti Library.

Lastly, it is with great appreciation to all participants that I say, we look forward to additional distinct articles for the benefit of all prosthodontists.

Hsiu-Na Lin
Editor-in-Chief

Original Article

Determining occlusal plane with the mandibular labial frenum as the anterior reference point.

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Abstract

Statement of problem: *The oral care of elderly people is important, especially in an aging society. It is critical for rehabilitation of oral function with fixed or removable dentures when dentists facing the edentulous patient. The appropriate occlusal plane and establishment of the vertical maxillomandibular relations can meet the functional and esthetic demands for fixed or removable dentures.*

Purpose: *The purpose of this study was to measure the distances between the mandibular labial frenum and the incisal edge of the lower central incisor in a cohort of patients in order to use the average values of those distances as anterior reference points for determining mandibular occlusal planes.*

Material and Methods: *Casts collected from the participating patients including the clear landmarks of the mandibular labial frenum and the mesioincisal edge of the lower right central incisor were measured with a digital vernier caliper by only one clinician.*

Results: *The mean distances between the attachment of the mandibular labial frenum and the mesioincisal edge of the lower right central incisor in the male, female and all subjects were 12.0 ± 1.4 mm, 11.4 ± 1.1 mm and 11.3 ± 1.2 mm, respectively.*

Conclusions: *Collecting the records of healthy adults with no obvious teeth wear could help to determine the vertical dimensions of mandibular occlusal planes and the positioning lower anterior artificial teeth when dealing with full mouth rehabilitation.*

Key words: lower central incisor, mandibular labial frenum, occlusal plane, vertical dimension

Introduction

The importance of long-term oral care for elderly people is increasing, especially in aging societies. According to a 2014 study by Wang[1],the prevalence of edentulism among individuals aged more than 65 years old in Taiwan was 24.3%. Hence, it is critical that dentists have an efficient and accurate means of reconstructing the occlusion when faced with fully edentulous elderly patients. Whenever fixed or removable dentures are

applied, an adequate occlusal plane is the key to success for full mouth rehabilitation. Specifically, the level of the occlusal plane created with the dentures should be as close as possible to the plane that was previously occupied by the natural teeth[2]. At such level, the occlusal plane of the dentures will allow the tongue and cheek muscles to function normally. Furthermore, a well-designed prosthesis is important for good esthetics, i.e., the level of the occlusal plane can affect the proportion of the teeth displayed when smiling[3,4].

There are many methods for determining the occlusal plane[5]. The most commonly used method is utilizing non-mobile anatomical landmarks to achieve reasonable estimates of the upper and lower occlusal planes[5]. The level of the upper occlusal plane can be determined using the interpupillary line and the ala-tragus line. However[6,7], there is little information regarding what anterior reference point to use in determining the lower occlusal plane. The anterior anatomical landmarks of the mandible are the labial frenum, lingual frenum and vestibule[8].The labial frenum is typically more visible than the lingual frenum in the mouth.

The labial frenum is a thin sheet of tissue that attaches to the center of the lower lip and between the lower two central incisors[9].It is quite notable, and its location can be accurately recorded. In the edentulous condition, it attaches to the labial aspect of the lower ridge at the midline. This anatomical landmark can be used for the proper positioning of lower anterior teeth in their original position and to establish the level of the lower occlusal plane in full mouth rehabilitation patients.

The goal of this study was to measure the distance between the mandibular labial frenum and the mesioincisal edge of the lower central incisor in order to obtain objective data for clinicians.

Materials and methods

The present study was conducted in the Department of Prosthodontics of Shin Kong Wu Ho-Su Memorial Hospital in Taipei, Taiwan. The Ethics Committee of Shin Kong Wu Ho-Su Memorial Hospital approved the research protocol. The study involved the 52 mandibular stone casts which were obtained with alginate impressions in stock tray from 26 male patients and 26 female patients of the prosthodontic department of Shin Kong Wu Ho-Su Memorial Hospital. The included stone casts should have the clear landmarks of the mandibular labial frenum and the incisal edges of the lower central incisors. The stone casts, which were made from 2014~2017, were selected for this study according to various inclusion/exclusion criteria.

The inclusion criteria were that the patient had to be aged from 21 to 25 years old and had to have a Class I dental relationship. The age criterion was due to the fact that the average eruption age of the lower third molar is 17-21 years old. Meanwhile, the average root completion age of the lower third molar is18-25 years old. When the root of the lower third molar is completed, the individual in question is considered to have complete dentition[10]. The exclusion criteria were having dental prostheses; having teeth with excessive attrition, wear, supraeruption, or mobility; or receiving orthodontic treatment and labial frenectomy.

Point markings were made on each mandibular stone cast using a ball point pen marker. One point was marked at the mesioincisal angle of the right mandibular central incisors, and another point was marked on the attachment of the labial frenum. The occlusal plane of each of the casts was made parallel to the horizontal plane using a cast paralleling device on a Ney dental surveyor.

Each mandibular stone cast was placed on the cast holder of the dental surveyor, then the paralleling metal plate fixed to the surveying arm perpendicularly was lowered and adjusted to establish contact with the plate in at least three widely divergent points, one anteriorly and two posteriorly, on both sides (Fig. 1).

After the occlusal plane was orientated, the surveying arm with analyzing rod was lowered until the tip of the analyzing rod contacted the mark on the superior attachment of the labial frenum (Fig. 2). The value was then recorded by using the digital vernier caliper directly (Fig. 3).

The second value could then be recorded when the analyzing rod was elevated to the marking point on the mesioincisal edge (Fig. 4). The distance between the superior attachment of the mandibular labial frenum and mesioincisal edge of the lower central incisor could then be calculated from the subtraction of those two values (Table 1). The distance values for the casts were statistically analyzed with SPSS24 for MAC. The mean and the standard deviation (SD) of the measurements for all the subjects were calculated and statistically analyzed.

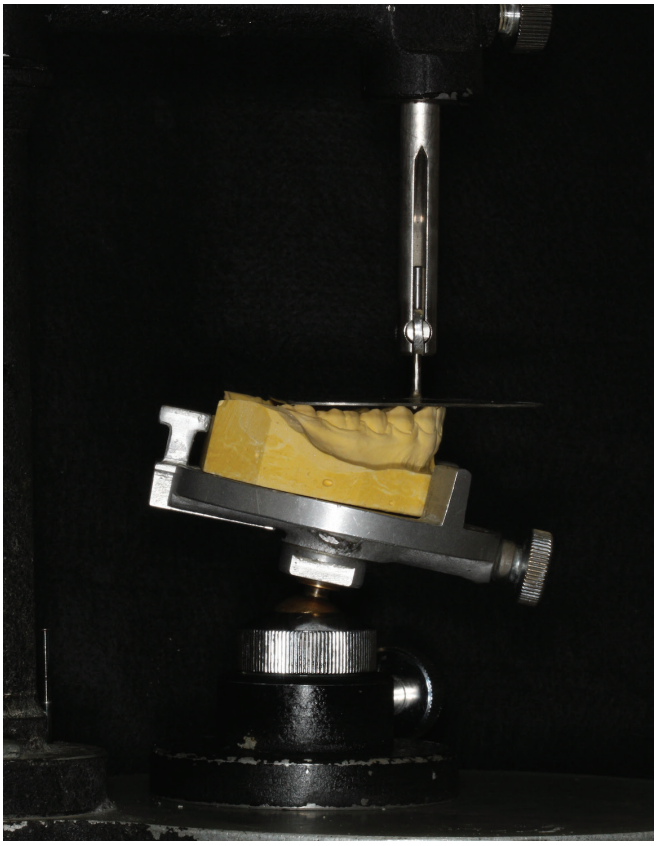

Figure 1. Cast paralleling device used to orient the cast on the surveyor.

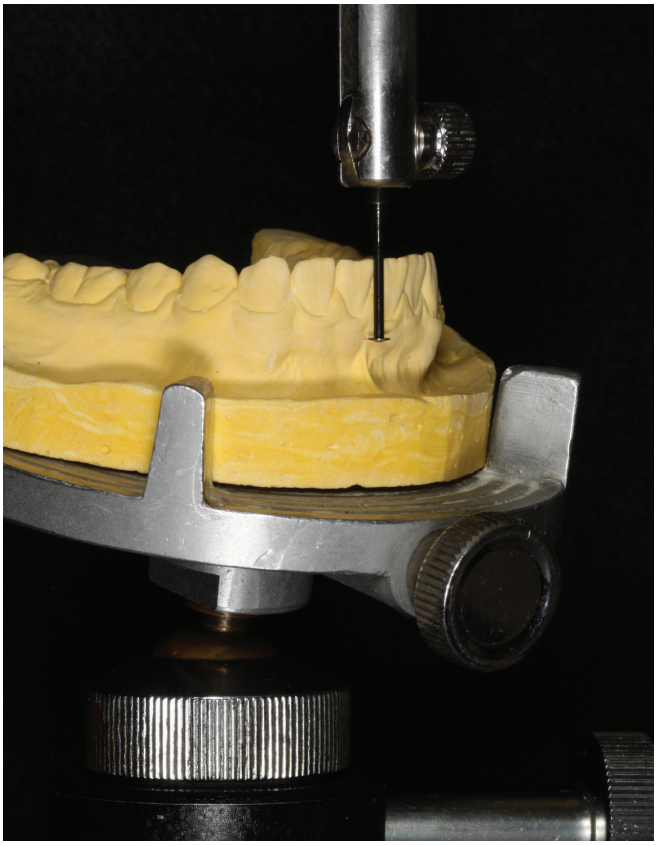

Figure 2. Analyzing rod contacting the superior attachment of the mandibular labial frenum.

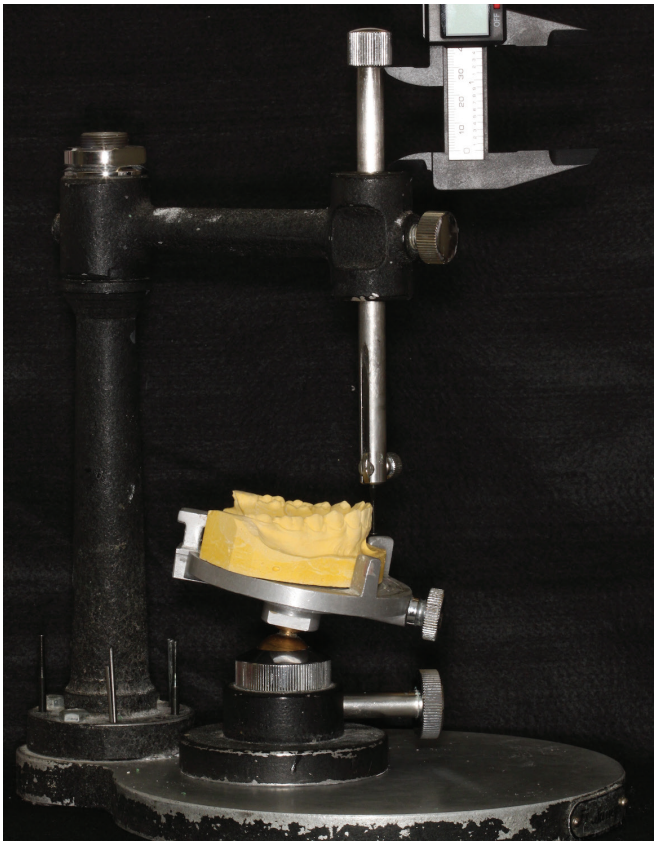

Figure 3. The distance between the two points on the vertical spindle of the surveyor was measured by a digital vernier caliper at the level of superior attachment of the mandibular labial frenum.

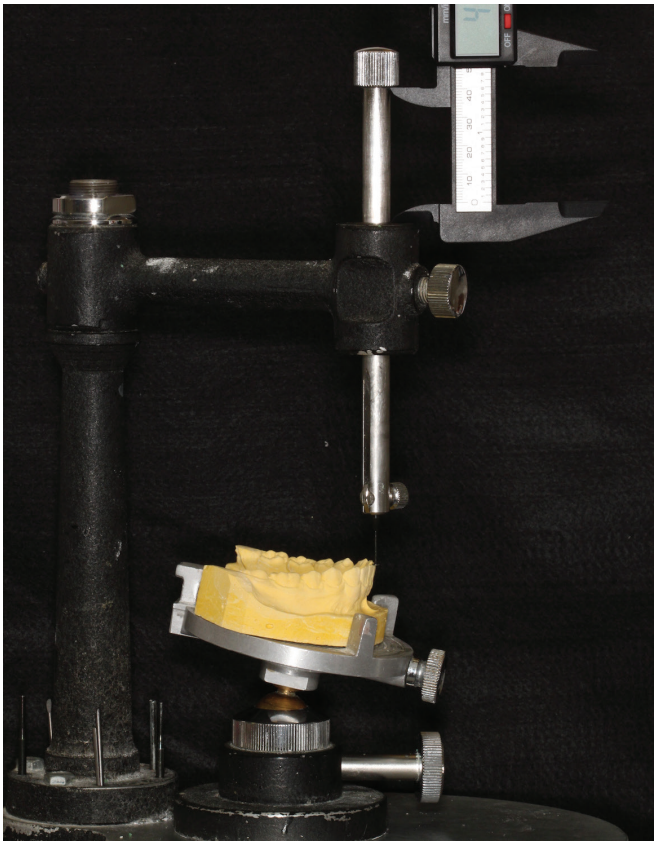

Figure 4. The distance between the two points on the vertical spindle of the surveyor was measured by a digital vernier caliper at the level of mesioincisal edge of the lower central incisor.

Table 1. Master table of values

MALE				FEMALE			
Patient No.	Model (in mm)	Patient No.	Model (in mm)	Patient No.	Model (in mm)	Patient No.	Model (in mm)
1	10.5	14	11.2	1	11.1	14	13.0
2	10.8	15	12.8	2	9.0	15	9.2
3	11.0	16	12.8	3	9.6	16	10.6
4	12.5	17	13.4	4	10.3	17	10.3
5	12.0	18	9.9	5	10	18	11.9
6	10.3	19	14.0	6	13.1	19	12.1
7	12.3	20	13.0	7	11.2	20	12.6
8	9.5	21	14.6	8	12.1	21	11.5
9	11.6	22	11.9	9	12.2	22	10.5
10	12.5	23	13.6	10	11.8	23	9.7
11	13.0	24	13.5	11	11.5	24	11.8
12	10.7	25	11.8	12	11.4	25	11.3
13	10.7	26	12.0	13	13.5	26	11.1

Results

The distances between the superior attachment of the mandibular labial frenum (MLF) and the mesioincisal edge of lower central incisor (LCI) in the male and female subjects are listed in Table1. The distance from the MLF to the LCI in all of the subjects ranged from 9.0 to14.6 mm, with mean (±SD) of 11.3 ±1.2 mm. In the male patients, ranged from 9.5 to14.6 mm, with a mean (±SD) of 12.0 ±1.4 mm, as in the female patients, ranged from 9 to13.5 mm, with a mean (±SD) of 11.4 ±1.1 mm (Table 2).

Table 2. Mean values and Standard deviation values (Mean ± SD)

	Total	Male	Female
Mean ± SD (in mm)	11.3 ± 1.2	12.0 ± 1.4	11.4 ± 1.1

Discussion

An adequate occlusal plane can fulfill esthetic demands, improve chewing efficiency and maintain the stability between the tongue and cheek; therefore, setting-up a reasonable occlusal plane is important for full mouth rehabilitation. However, when dealing with a patient on fully edentulous ridges or posterior teeth loss with remaining lower anterior teeth, it is hard to achieve a reliable occlusal plane. It is especially difficult to do so when a patient has supraerupted anterior teeth or even combination syndrome. In short, it is frequently a challenge for dentists to accurately determine the anterior occlusal plane.

There are many measurement methods used to determine the appropriate occlusal vertical dimension, including the mechanical, physiological and esthetic approaches. However, the level of the occlusal plane is most commonly determine based on anatomical landmarks[11]. Hence,pre-extracion records are often used to measure the occlusal plane[5]. The level of the upper occlusal plane can be obtained from hamular notch-incisive papilla[12] or the interpupillary line combined with the ala-tragusline.[8] With respect to the mandibular occlusal plane orientation, the retromolar pad is often used as a posterior reference point[13]. The retromolar pad is relatively stable, even when the ridge severely resorbed. Meanwhile, many researchers have also surveyed various anterior reference points, including the lateral border of the tongue[14], the commissure of the lips[11], the buccinators groove[11] and the mucolabial reflection[15]. However, there is much variation in anatomical landmarks, such that in comparison, the mandibular frenum is relatively stable.

The frenum is divided into the labial frenum and the lingual frenum. Many studies have used the lower lingual frenum as a landmark. But it was found that the superior attachment could be bundles not a single frenum. It is therefore difficult

to define the superior attachment. Furthermore, if the dentist wants to check the occlusal plane in the mouth, this frenum is difficult to distinguish when wax-denture is inserted. By comparison, the labial frenum is relatively easy to measure and mostly consists of a single frenum. As such, if the clinician takes an impression carefully, this anatomical mark can be easily measured.

Various methods used to measure the distances between two anatomical landmarks have been presented in previous studies. Among the most common, the first consists of using a divider to measure two given marks and then transferring the marks to a white sheet[16]. The distance between the carbonmarksis then obtained using a digital vernier caliper. The shortcomings of this approach are that it does not orient the occlusal plane and that errors may occur when transferring the marking points to the white sheet. The second method consists of placing the study cast on the surveyed table,and then orienting the occlusal plane so that it is parallel with the horizontal plane[17]. After the occlusal plane orientation, a surveying arm with analyzing rod is lowered until the tip of the analyzing rod contacts the mark on the superior attachmentof the labial frenum. A horizontal mark is then made with a ball point pen marker on the vertical arm of the surveyor where it meets the horizontal arm. Similarly, a second horizontal mark is made on the vertical arm of the surveyor where it meets the horizontal arm, when the tip of the analyzing rod is made tocontact the mark on the mesioincisal angle of the central incisors. However, this second method also has one disadvantage, which is that the marking on the vertical arm can also be in error. As such, the present study used a modified version of the second method to prevent such errors when collecting the measurement data.

In the present study, the subjects were Taiwanese, and according to the data collected, the distances ranged from 9.5 to 14.6 mm, with a mean (±SD) of 12.0 ±1.4 mm in the male patients, and from 9.0 to 13.5 mm, with mean (±SD) of 11.4 ±1.1 mm in the female patients. These data are valuable to clinicians when making the wax rim before the vertical dimension appointment. Moreover, the method used in the present study is reliable. This is because when the resulting denture is delivered, the dentist can still use the digital vernier caliper to check the occlusal plane. It is thus efficient to use the mandibular labial frenum as the anterior reference point when determining a reasonable occlusal plane.

The anterior teeth not only have functional needs but also esthetic demands. The upper anterior reference point is superior to the lower one. The upper teeth disclosed could be affect the older or younger, but the muscle tone decreases with age and also having teeth wear the lower teeth disclosed will increase. Hence, the important of the lower teeth increases over time. However, pre-extraction records alone cannot be effectively used to determine the levelof the occlusal plane; rather, they need to be used in combination with another method to determine the appropriate occlusal plane.

Although previous studies measured the distance between the mandibular lingual frenum and lower central incisor, the results of this study can still be compared with those of previous ones.

In the study by Bissasu[17], the results showed the reliable measurement of the distance between the anterior attachment of the lingual frenum and the incisal edges of the mandibular incisors. The results also showed a mean vertical distance of 10.26 mm in a Syrian population (consisting of nine males and nine females). In the study by Rahman et al.,[18] the mean vertical distance between the anterior attachment of the

lingual frenum and the incisal edges of the mandibular central incisors was 10.7 mm in males and 10.9 mm; in females in an Iraqi population (consisting of fifteen males and fifteen females).

In the study by Parimala and Prithviraj[19], the mean vertical distance between the anterior attachment of the lingual frenum and the mesioincisal edges of mandibular central incisors was 12.3 mm in males and 11.9 mm in females in an Indian population (consisting of fifty-sixmales and forty-four females).

In the study by Balasubramanian et al.,[16]the mean distance between the anterior attachment of the lingual frenum and the mesioincisal edges of the mandibular central incisors was 14.5 mm in a south Indian population (consisting of fifty-six males and forty-four females).

In the study by Mahboub et al.,[20]the mean vertical distance between the anterior attachment of the lingual frenum and the mesioincisal edges of the mandibular central incisors was 15.42 ±0.97 mm in males and 13.28 ±1.57 mm in females in an Iranian population (consisting of twenty males and twenty females).

All of these studies adopted the aforementioned

second method, with the exception of the Balasubramanian et al. study. Overall, their reported values ranged from10.26 mm to15.42 mm. The mean vertical distance for all the subjects in the present study, meanwhile, was 11.3 mm. This value was similar to those reported in the previous studies.

The advantage of the present study's measurement method is that it is relatively easy to perform, the reason being that the labial frenum is easy to distinguish and the line between the labial frenum and incisal edge of the lower central incisors is more perpendicular to horizontal plane than the lingual frenum. This may, in turn, save on orientation set-up time and the results of the method can be checked chair-side.

Conclusion

The following conclusions were drawn from this study:

1. The distances between the attachment of the mandibular labial frenum and mesioincisal edge of the lower central incisors in the male, female, and all subjects ranged from 9.5 to14.6mm, with a mean (±SD) of 12.0±1.4mm; from 9 to 13.5mm, with a mean (±SD) of 11.4±1.1mm; and from 9 to 14.6 mm, with a mean (±SD) of 11.3±1.2mm, respectively.
2. Collecting the records of healthy adults with no obvious teeth wear could help to determine the vertical dimensions of mandibular occlusal planes and thus be used in their rehabilitation. The objective results of this study could thus help clinicians to efficiently determine the occlusal plane when dealing with full mouth rehabilitation.
3. The results of this study can be used in positioning lower anterior artificial teeth.

Clinical implication

For full mouth rehabilitation, the importance of obtaining a reasonable occlusal plane level is paramount. Using the mandibular labial frenum as an anterior reference point for determining the occlusal plane level is easy to do, and the results can be re-checked chair-side.

Conflicts of interest

All the authors state that they have no potential sources of conflict of interest.

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Original Article

Digital Measurement of Abrasion Volume of Dental Luting Cement at Different Locations of Natural Tooth

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Running title: Dental cement's abrasion resistance of different positions

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Abstract

Purpose: *As the dental root is exposed to the oral cavity, the margin of the fixed partial denture may be located at the crown, neck, or root. The purpose of this in vitro study was to evaluate the abrasion resistance of different dental luting cement at different locations of natural teeth.*

Materials and methods: *A total of thirty-six premolars were divided into four groups with an artificial gap 1mm (±0.15 mm) in depth and 0.2 mm (±0.05 mm) in width at three locations (crown, neck, and root) filled with water-based luting cement, zinc phosphate cement (ZPC), polycarboxylate cement (PC), and resin-based dental resin cement 1 (U200), and resin cement 2 (Maxcem) (n=9). In the abrasion test, all specimens were tested using an abrasion-resistant testing machine with 2 N brushing forces mixed with toothpaste and water (1: 2). Each sample underwent the wear test of 18,000 cycles of brushing, 60 times per minute. 3D-printing software 3D Sprint® (3D system) and exocad DentalCAD (exocad GmbH) software were used to measure the amount of abrasion. Statistical analysis was performed by using one-way ANOVA and repeated-measure ANOVA (α=0.05).*

Results: *From the average wear perspective of average wear, PC had the most considerable amount of abrasion, followed by ZPC, Maxcem, and U200. The average amounts of crown, neck, and root abrasion of PC were 0.403±0.212, 0.482±0.354, and 0.27±0.153 mm^3, while the average amounts of crown, neck, and root abrasions of U200 were 0.123±0.057, 0.083±0.04, and 0.086±0.042 mm^3 respectively. Among the four adhesives, the amount of abrasion on different positions of the teeth showed no significant difference (P>.05); however, water-based and resin-based luting cement were significantly different (P<.05).*

Conclusion: *This study indicated that resin-based cement is more resistant to brushing than water-based cement. There was no significant difference in wear when the same adhesive was used at different locations of the tooth.*

Key words: anti-abrasion test, water-based cement, resin-based cement, natural tooth

Introduction

When rehabilitating oral cavity with fixed partial dentures, the smallest possible marginal discrepancy between the prosthesis and abutment tooth to minimize the risk of disease development is the essential criteria. Although the marginal opening of the fixed partial denture is not clinically detected, the microscopic gaps are set in approximately 100 μm sufficient for penetration of bacteria[1,2]. Luting cement is designed to fill the microscopic gaps between a prosthesis and a prepared tooth. Cement is classified as water-based, oil-based, or resin-based products. Zinc phosphate cement (ZPC), zinc polycarboxylate cement (PC), and glass-ionomer cement (GIC) are all water-based cement with phosphate bonding or polycarboxylate chelation. Zinc oxide-eugenol cement is an oil-based cement that is useful for short-term cementation of the prosthesis, while resin-based luting cement is a variety of tooth-colored resins with high strength and low film thickness. ZPC and PC luting cement bond to the tooth structure via acid and metal oxide bases to form a salt and water. The anti-abrasion ability might be related to the property of tensile bond strength, solubility, and microleakage. Parameswari et al. [3] measured the tensile bond strength of ZPC, GIC, and PC, ZPC was found more efficacious than PC, which concluded that the PC might be weaker associated with the reduced film thickness. In terms of solubility, Karkera et al. [4] tested GIC, ZPC, polyacid-modified resin cement, PC and resin-modified glass ionomer (RMGIC) respectively. Among the above, the solubility to water for both ZPC and PC are similar. With regard to microleakage, Mohajerfar et al. [5] evaluated ZPC, glass-ionomer, Speed CEM and Panavia, while Vesna Medić et al. [6] assessed ZPC, PC, glass-ionomer and resin cement. Both parties obtained the result that ZPC had the highest microleakage and PC had microleakage close to ZPC, thus it is controversial to compare the anti-abrasion abilities of PC and ZPC.

When it comes to resin cement, they generally have good physical properties, such as high compressive and tensile strengths, and are not easily soluble in water. There are three types of resin cement: total etch-and-rinse adhesives, self-etch adhesives, and self-adhesives. The self-adhesive resin cement without separate adhesive steps has become more and more popular for clinical use. Studies have shown that the self-adhesives' mechanical properties such as shear bond strengths and bonding resistance are not as effective as those of three-step resin cement[7-11]; besides, Furuichi[7] compared five self-adhesive resin cement (G-CEM LinkAce, BeautiCem SA, Maxcem Elite, Clearfil SA Automix, and RelyX Unicem 2) and found that Maxcem had the most volume loss after measuring the wear resistance of various resin cements.

Attrition will induce loss in occlusal enamel and no antagonist causes an abnormal eruption of the tooth. Another reason for root exposure is gingival recession[12] or crown-lengthening procedure[13]. Most enamel crystals are rod-shaped to form enamel prisms, and there are insufficient data of morphological and microchemical changes in the enamel associated with possible sign of aging[14]. The anatomic root is found below the neck and is covered with cementum. Restoration margin placement is important for those teeth where retention and resistance form is needed. The contour of the tooth may require alteration for both biological and esthetic reasons and maintain a good level of hygiene is a must.[2,15]

While preparing the tooth for a fixed partial denture, the margin of the fixed partial denture may be located at the crown, neck or root. As there are no studies on brushing resistance at different natural tooth positions, this study aimed to examine the anti-abrasive ability of different dental luting cements at different natural teeth locations under the same brushing frequency and intensity.

Materials and methods

Thirty-six premolars were collected in this study. This study was approved by the Human Research Ethics Committee of Kaohsiung Medical University Chung-Ho Memorial Hospital IRB, Kaohsiung ROC. (IRB code: KMUHIRB-E(II)-20190243).

Extracted human teeth without caries or filling restoration were stored at room temperature and used as tooth specimens. No cervically abraded teeth were included in this study.

Figure 1 shows that 5 mm above the premolars' neck and 5 mm below the neck was retained and embedded in the composite resin ring with the buccal side up. Then, two re-entrant angles off the composite resin ring were cut to let the teeth steadily stand on the pedestal of the 3D Coordinate Measuring Machine (3D CMM). Finally, low-speed handpieces (ULTIMATE XL - NSK-Nakanishi International) were used to create an artificial cut with 1mm (± 0.15 mm) in depth and 0.2 mm (± 0.05 mm) in width at three locations, being crown,

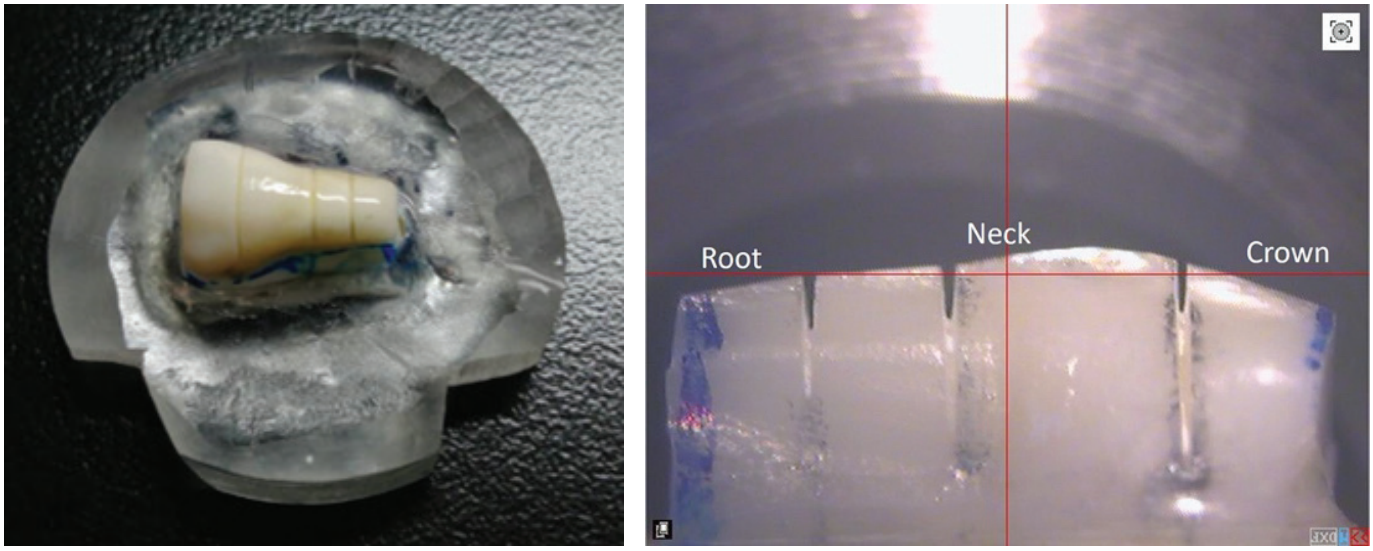

Figure 1. Pictures of sample with three artificial cut in 3D CMM. A. labial view B. proximal view.

Table 1. Component of Dental cement tested in anti-wearing test.

Code	Type	Product	Manufacturer	Lot No.
PC	Polycarboxylate	GC-Livcarbo	GC	1805011
ZPC	Zinc Phosphate	Super Cement	SHOFU	051547
Maxcem	Self-adhesive resin	MAXCEM	KERR	7040052
U200	Self-adhesive resin	RelyX U200	3M	4668351

neck, and root (Fig.1). The 0.2 mm (± 0.05 mm) in width simulated the marginal gap.

The following four materials were used to evaluate the anti-abrasive ability of dental cement. GC-Livcarbo (PC, Tokyo, Japan) was used to present polycarboxylate cement, SHOFU Super Cement (ZPC, Kyoto, Japan) was used to present zinc phosphate, and MAXCEM Elite Chroma (MAXCEM, KERR CA, USA) and RelyX U200 (U200, 3M, Germany) were used to present self-adhesive resin (listed in Table1). We distributed all 36 samples into four groups randomly, being PC, ZPC, Maxcem, and U200 respectively.

All of the samples were filled with the cement, which was mixed according to the manufacturer's recommended procedures. Finally, the samples were set completely before testing for both PC and ZPC; as for the other groups that included Maxcem and U200, samples were cured by dental curing light following the manufacturer's recommended time set.

The height that counts from the junction of tooth and composite resin ring to the most convex point at the surface at crown, neck and root were recorded with the 3D CMM and exocad DentalCAD (exocad GmbH) after filling with the cement. The Initial specimens were scanned with desktop scanner (3Shape, Copenhagen, Denmark), and initial data were stored as STL files.

In the abrasion test, six premolars that being unprepared were used as a pilot study. The machine used was an abrasion-resistant testing machine (PAT2012 fully automatic abrasion, Bo Yi Jing, Taiwan). The American Dental Association recommends brushing the teeth twice a day and for at least 2 min [16]. To simulate the real brushing force (2 Newtons) [16], we placed 200g on the toothbrush, then added toothpaste (SENSODYNE RAPID RELEIF) mixed in water with a ratio of 1: 2, and each sample underwent the wear test of 18,000 cycles of brushing, 60 times per minute. The wear volumes were accounted for by a 3S sprint (3D System, USA).

One-way ANOVA was used to analyze the difference between the amount of abrasion of each cement on the same tooth location, using repeated-measure ANOVA to analyze the difference between abrasion at three different locations when using the same cement. The G*Power version 3.1.9.2 was applied to estimate the sample size (Franz, Universitat Kiel, Germany), and the power analysis was used for a fixed effect

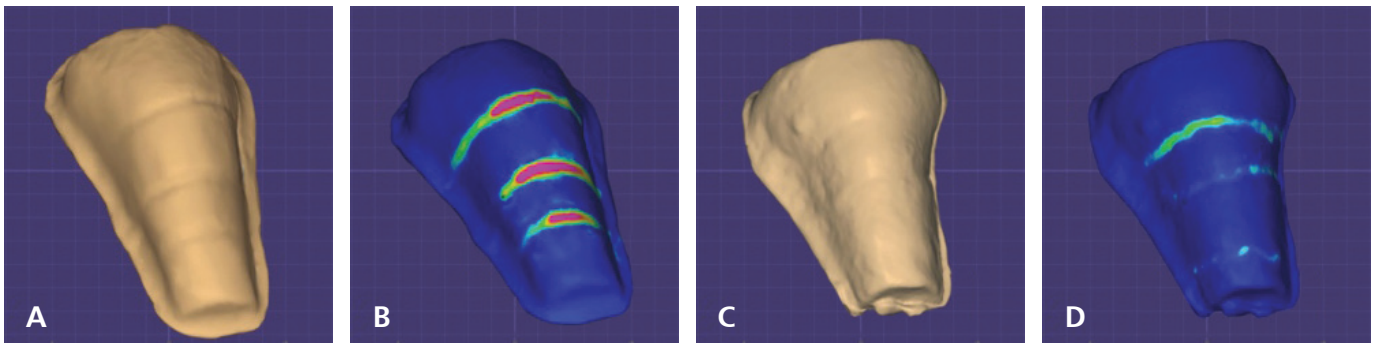

Figure 2. The abrasion picture of water-based and resin-based luting cement. A. STL file of ZPC after rest. B. 3D image superimposition before and after test of ZPC at crown, neck, and root. C. STL file of U200 after test. D. 3D image superimposition before and after test of U200 at crown, neck, and root.

Table 2. Abrasion of different types of cement and locations of marginal gap after anti-abrasive test (mm^3).

Cement \ The location of cut	Crown M ± SD	Neck M ± SD	Root M ± SD	P value (same cement vs. different location)
PC (n= 9)	0.403±0.212	0.482±0.354	0.27±0.153	neck vs crown=0.1679 Crown vs root=0.4803 neck vs crown=0.7681
ZPC (n=9)	0.367±0.08	0.32±0.127	0.267±0.115	neck vs crown=0.1207 Crown vs root=0.5318 neck vs crown=0.6070
Maxcem (n=9)	0.16±0.076	0.152±0.042	0.134±0.09	neck vs crown=0.7602 Crown vs root=0.9137 neck vs crown=0.9504
U200 (n=9)	0.123±0.057	0.083±0.04	0.086±0.042	neck vs crown=0.7113 Crown vs root=0.8285 neck vs crown=0.9771

Different superscript letters in a column indicate statistical significance among groups.

P<0.05 * (post hoc Dunnett T3 test) *

One-way ANOVA; Repeated-measure ANOVA; M: Mean; SD: Standard deviation

one-way ANOVA. With a significant criterion of α=0.05 and an estimated effect size of 0.67, the power was at least 82.39%.

Results

In the pilot study, there was no significant difference in the process of before and after brushing.

The average crown, neck, and root abrasions of nine samples that used PC were 0.403±0.212 (mm^3), 0.482±0.354 (mm^3), and 0.27±0.153 (mm^3) respectively. In nine samples that used ZPC, the average crown, neck, and root abrasions were 0.367±0.08 (mm^3), 0.32±0.127 (mm^3), and 0.267±0.115 (mm^3) respectively. The average crown, neck, and root abrasions of nine samples that used Maxcem were 0.16±0.076 (mm^3), 0.152±0.042 (mm^3), and 0.134±0.09(mm^3) respectively. The average crown, neck and root abrasions of nine samples that used U200 were 0.123±0.057 (mm^3), 0.083±0.04 (mm^3), and 0.086±0.042 (mm^3) respectively. Figure 2 shows the water-based and resin-based luting cement superimposition images before and after testing. These results are listed in Table 2. There was no statistical significance at different locations on the samples using different cements.

Table 3 shows the different materials at crown, neck and root representing the four cement abrasions all had a statistical difference (P< 0.05). Moreover, for the margin at crown and root,

the abrasion volume of resin-based cement was significantly different from that of water-based cement. For the margin at neck area, P-value equaled 0.0002 representing the abrasion of the four cements exhibited statistical difference; however, besides U200 vs Maxcem and PC vs ZPC, ZPC vs Maxcem showed no significant difference at the neck area for anti-abrasion volume (P= 0.217). Further analysis of the statistical dependence between the two materials at the same location is shown in Table 3.

Table 3. P value between materials under the same tooth location.

The location of cut / Cement	Crown	Neck	Root
P value (same location versus different cement)	<0.0001*	0.0002*	0.0005*
PC versus Maxcem	0.0005*	0.041*	0.0362*
PC versus U200	<0.0001	0.0002*	0.0027*
ZPC versus Maxcem	0.0031*	0.217	0.0419*
ZPC versus U200	0.0004*	0.002*	0.003*
Maxcem versus U200	0.906	0.245	0.751
PC versus ZPC	0.9125	0.8491	0.9999

Discussion

The results showed that the four cements had significant wear at crown, neck and root respectively; however, at different tooth positions, the trend was similar, although the water-based cement had a higher abraded volume than resin-based ones. Only ZPC versus Maxcem at the neck area showed no significant difference by using the Dunnett T3 post-hoc test. The factors might be the morphology at the neck area being more convex and easily worn, however, abraded volume for ZPC (water-based) was still higher than Maxcem (resin-based).

This finding was consistent with Trumpaite-Vanagiene's research[17]. He also indicated that water-based cement was inclined to wear due to its material property and powder-liquid formulation; similarly, Fernando Carlos Hueb had noted that the polymers formed during the polymerization process incorporated water molecules through hydrogen[18-20], altering the composition of the solid substances formed. This cross-binding enhances the microhardness of resin-based cement and makes it more durable to the ones that are water solution derived[21].

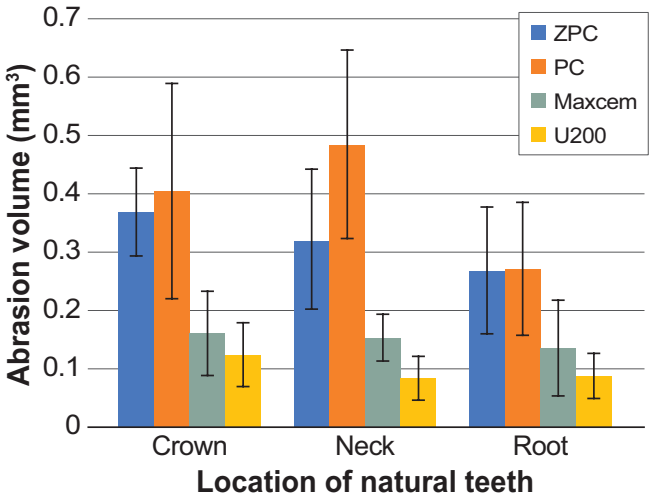

Figure 3. The abrasion of different locations and cements.

Further analysis of PC and ZPC differences revealed that PC has higher average abrasion than ZPC (Fig 3.). Therefore, despite both PC and ZPC being water-soluble dental cements, ZPC showed better abrasion resistance[20,22,23]. ZPC is a water-based material which is fully set following by acid-base reaction between zinc-oxide powder and an aqueous phosphate acid solution. Polycarboxylate cement is mainly formed by zinc oxide and polyacrylic acid in water, and these two materials showed the hydrophilic nature of a polymer in the results of monomers and polymerization linkages; however, the PC presents hydroxyl, carboxyl groups in monomers and their resultant polymer make them more hydrophilic and more prone to water absorption in their formulation. Ghanim has confirmed these findings[24].

This study determined that the polycarboxylate cement showed the highest value of abrasion followed by zinc phosphate. The two types of resin-based cement revealed that their abrasion-tested values were much lower than it is for the water-based cement. The anti-abrasive ability would be influenced more by cement types rather than the position where the cement was filled. These results could further infer that the anti-abrasive ability might be associated with the cement's water solubility of cement used. Neshandar Aslli et al discovered that PC is the most water-soluble, follow by ZPC, and the resin-based cement is the least soluble one[25].

The results showed that ZPC wear on the

crown tended to be greater than the wear on the neck and root. These factors might be related to the structure of dentin and enamel. After cutting, the dentin will have many cross-cut dentin tubules on the cut surface, and the cut surface of the enamel will be relatively smoother. Although the formation process is formed by stacking layers of rods, interrod enamel will fill the gaps in the formation of rods[26], so the dentin tubules on the dentin provide a rougher environment than does enamel. On the other hand, It might be due to PC was more prone to water solubility and the neck's morphology was more convex and therefore more readily contacted by the brush, thus PC wear at the neck was greater than that at the crown and root..

The purpose of this experiment was to determine the anti-abrasive ability of different cements when the cement was applied to the different locations of crown, root, or neck. However, the study's limitation was the insufficient sample size, which needs to be increased to gather more evidence and the morphology of tooth size, which could not be controlled completely. Further research could evaluate the property of tensile bond strength, solubility of luting cement, apply additional cement types, samples and change the brush force to validate the anti-abrading ability of dental luting cement.

Conclusions

Within the limitations of this study, the following conclusions can be drawn:

1. Resin-based cement performs better in abrasion resistance than water-based cement.
2. There is no significant difference in the amount of wear at three different tooth locations when using resin-based or water-based cement.

Conflicts of interest

The authors declare no conflicts of interest.

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Case Report

Immediate implant placement and provisionalization after staged approaches of apicoectomy and guide tissue/bone regeneration in the anterior maxilla: A clinical report

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Abstract

In order to maintain esthetics immediately after maxillary anterior tooth extraction, immediate implant placement and provisionalization (IIPP) is one of the current options for implant reconstruction. However, esthetic outcome after IIPP is depended on proper condition of the preexisting tissue. This clinical report introduces the strategy of apical surgery and guided tissue/bone regeneration before tooth extraction to improve the preexisting tissue condition. It could not only achieve the patient's esthetic demand, but also prevent the risk factors for IIPP.

Key words: apical surgery, guided bone regeneration, guided tissue regeneration, immediate implant placement, immediate provisionalization

Introduction

The reconstruction of partially or fully edentulous patients with implant-supported prostheses has become a reliable and predictable treatment option resulting in high survival rates[1]. However, it's still a challenge to achieve a satisfying esthetic outcome with healthy and stable peri-implant tissues in harmony with the adjacent natural teeth in anterior maxilla by using implant restorations. Three implant protocols have been evolved based on the different surgical conditions and surgeon demanding, including immediate, early and delayed implant placement.

There is a growing tendency to place implants immediately after tooth extraction, combined with immediate provisionalization. Immediate implant placement was initially described by Schulte and Heimke in the 1980s[2]. Thereafter, the protocol of immediate loading was initially developed for improving patient's comfort through immediate function and esthetics. Since 1998, after Wohrle first demonstrated success with immediate implant placement and provisionalization (IIPP) of single anterior maxillary implants, numerous clinical studies have confirmed the viability of such treatments[3]. One of the most desirable features is the efficiency in optimizing esthetic success by preserving the existing osseous and gingival architecture. In addition, reduction in the number of surgical interventions, a shorter treatment time, an ideal three-dimensional implant positioning and especially, esthetic appearance and space maintenance during surgical healing period have been claimed as the advantages of this

treatment approach[4]. Moreover, it is also a predictable procedure with a high success rate. According to a prospective study by Kan et al[5]. with an average observation period of four years (2 to 8.2 years), the cumulative success rate of 35 anterior single implants by using immediate implant placement and provisionalization (IIPP) was 100%. The systematic review by Paul Weigl included 626 censored IIPP in 609 patients showed a success rate of 97.96% and a survival rate of 98.25% after a mean follow-up period of 31.2 months[6]. It provides not only early healing of the soft tissue surrounding the implant, but retains the alveolar crest and maintain the gingival architecture surrounding the implant. When immediate implant placement is combined with immediate provisional prosthesis restored, it will also decrease gingival change, especially for papilla height maintenance. Many authors had claimed that IIPP is effective in maintaining the existing papilla height without the risk of creating scar tissue, when flapless approach is implemented[7,8].

Esthetic outcome after IIPP is depended on proper condition of the preexisting tissue, such as a thick gingival biotype, an appropriate gingival level, osseous-gingival relationship, and the presence of adequate buccal bone plate[9]. It increases the risk of facial gingival recession in the cases with thin tissue biotype or facial bone dehiscence. Moreover, primary stability, control of micro-motion, and ideal implant position are also key factors to influence the success rates of IIPP[10]. The surgical protocol of IIPP should include the evaluation of bone quality, proper implant size choosing, and palatal insertion in flapless approach to achieve adequate implant primary stability and preserve labial bone plate. Then, the bone grafts at the gap between the implant and labial bone plate combined with facial connective tissue graft will also reduce the incidence of gingival recession and labial bone resorption after provisional implant prosthesis delivered[11,12].

This clinical report introduces the strategy of apical surgery and guided tissue/bone regeneration before single tooth extraction or combined serial tooth extraction to improve the preexisting tissue condition before IIPP achieving the esthetic outcomes.

Clinical report

Case 1:

A 47-year-old woman, had suffered from biting pain for a long time in the anterior maxilla. After comprehensively clinical and radiographic examinations (Fig. 1), a large periapical lesion was noted at maxillary left central incisor. No gingival swelling, inflammation, or deep probing depth above 3 mm were observed in the clinical examination. Tooth extraction was indicated due to insufficient remaining tooth structure and poor crown-to-root ratio after removing the previous metal-ceramic crown. The diagnosis was an apical cyst with a previously treated root canal. Because of patient's esthetic demand during healing period, IIPP was preferable and planned. However, the computed tomographic (CT) images showed insufficient vertical bone height for implant primary stability because of the apical lesion. Therefore, apical surgery and guide bone regeneration were planned prior to tooth extraction and implant

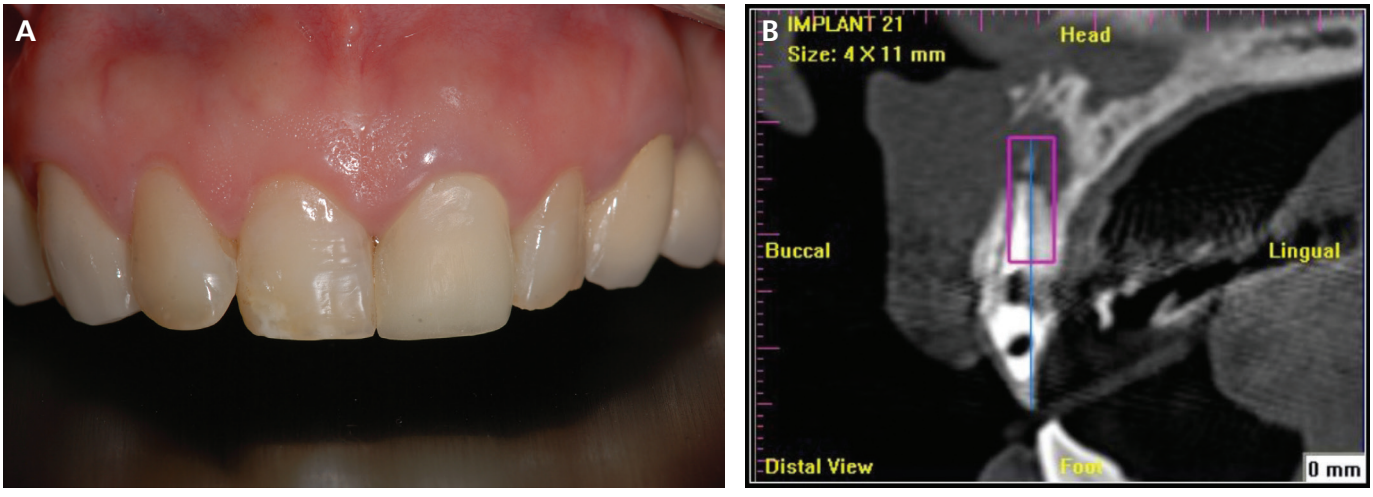

Figure 1. (a) Provisional crown on maxillary left central incisorPt, (b) CT image showed a large periapical lesion.

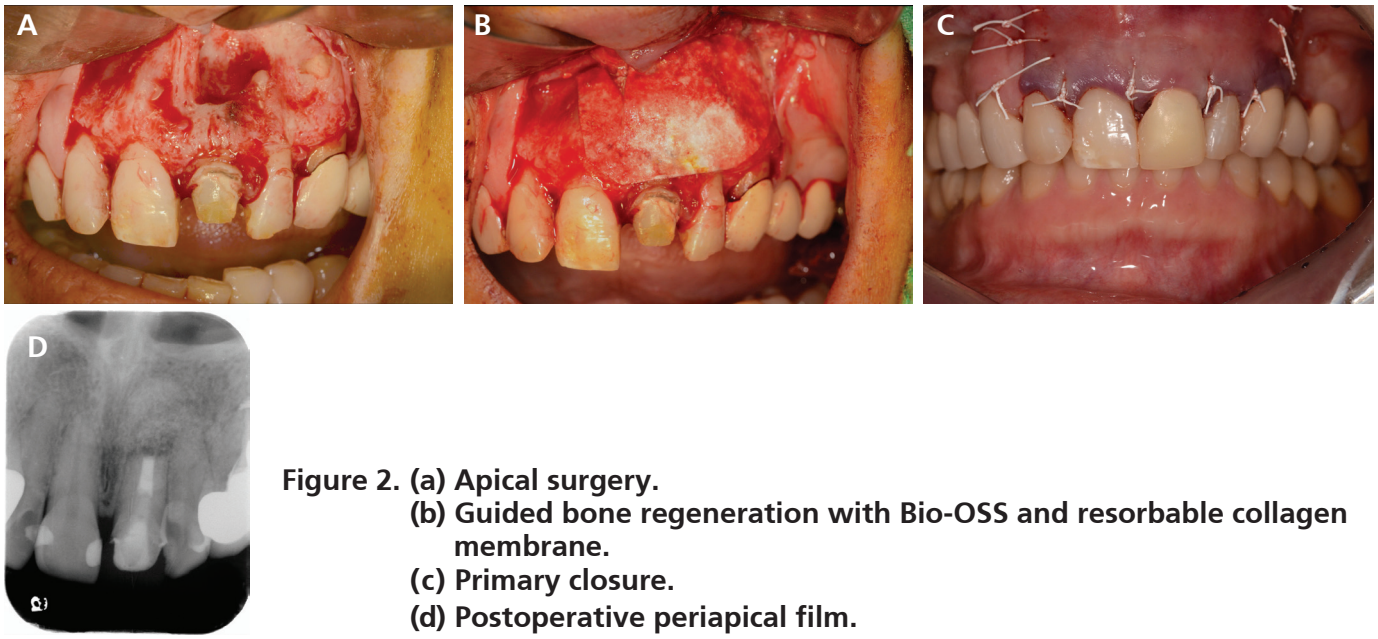

Figure 2. (a) Apical surgery.
(b) Guided bone regeneration with Bio-OSS and resorbable collagen membrane.
(c) Primary closure.
(d) Postoperative periapical film.

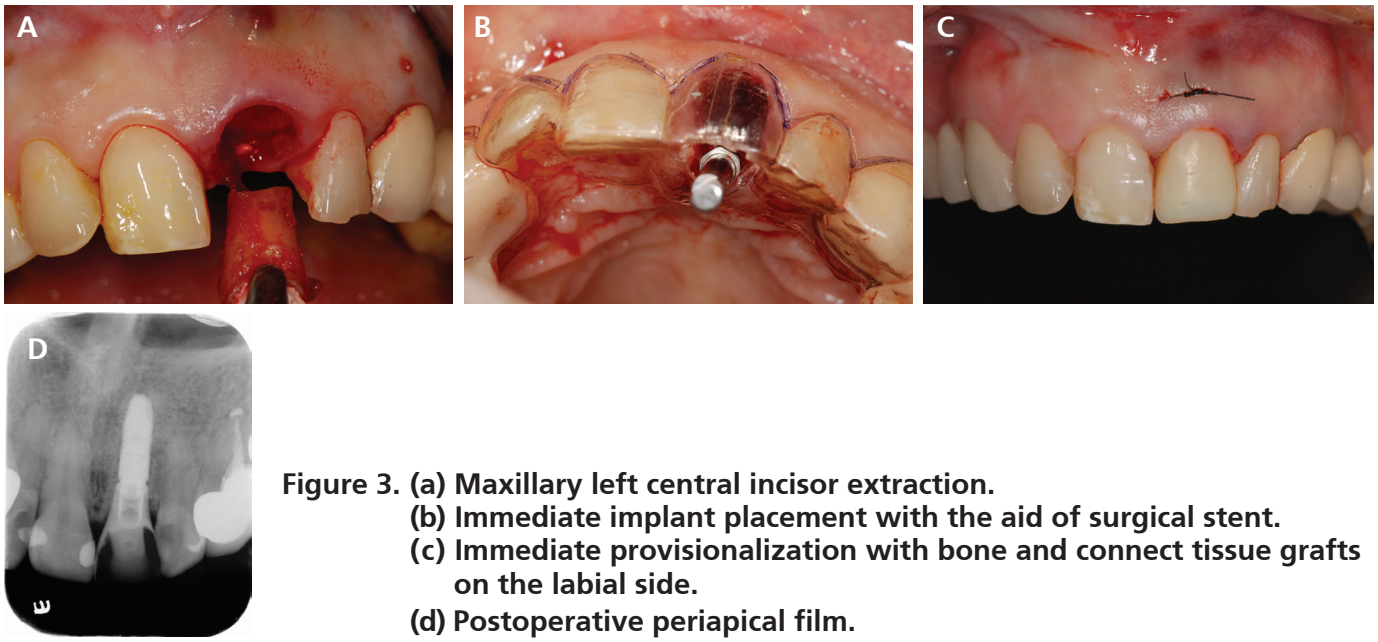

Figure 3. (a) Maxillary left central incisor extraction.
(b) Immediate implant placement with the aid of surgical stent.
(c) Immediate provisionalization with bone and connect tissue grafts on the labial side.
(d) Postoperative periapical film.

placement for the preparation of the pre-existing tissue condition. Regarding the apical surgery, cyst enucleation, apicoectomy, and retrograde filling with mineral trioxide aggregate (ProRoot MTA, Densply) were performed. Then, guided bone regeneration was performed with xenograft (Bio-OSS, Geistlich) and resorbable collagen membrane (EZ Cure, Biomatlante) (Fig. 2).

After bone healing for 8 mouths, maxillary left central incisor was extracted atraumatically, and an implant (OsseoSpeed™ EV, 3.6×11mm, Astra Tech) was inserted with primary stability of ≥30 Ncm^2 by using flapless approach. Auto-polymerized bisacrylic composite resin (Protemp 3 Garant; 3M ESPE) and titanium temporary abutment (Temp Abutment EV, Astra Tech) were used to make the screw-retained provisional crown. Then, the gap between the implant and labial bone plate was filled with bone grafts (FDBA, LifeNet) after implant-supported provisional crown inserted intra-orally without neither centric or eccentric occlusal contact. Thereafter, connective tissue graft harvested from maxillary palatal mucosa was applied on the facial side (Fig. 3).

After 3 months of osseointegration, final impression was made by using customized impression coping and polyvinyl siloxane (Aquasil Ultra XLV and Aquasil Soft Putty; Dentsply Caulk), and the definitive screw-retained implant-supported crown with porcelain-fused-to-zirconia design (Ceramill Zi, Amann Girrbach AG; veneer porcelain: Vita VM9) was delivered[12-14]. It achieved a satisfied pink and white esthetic outcomes in harmony with the adjacent natural teeth

Figure 4. Insertion of definitive screw-retained implant-supported crown.

Figure 5. Three-year follow up.

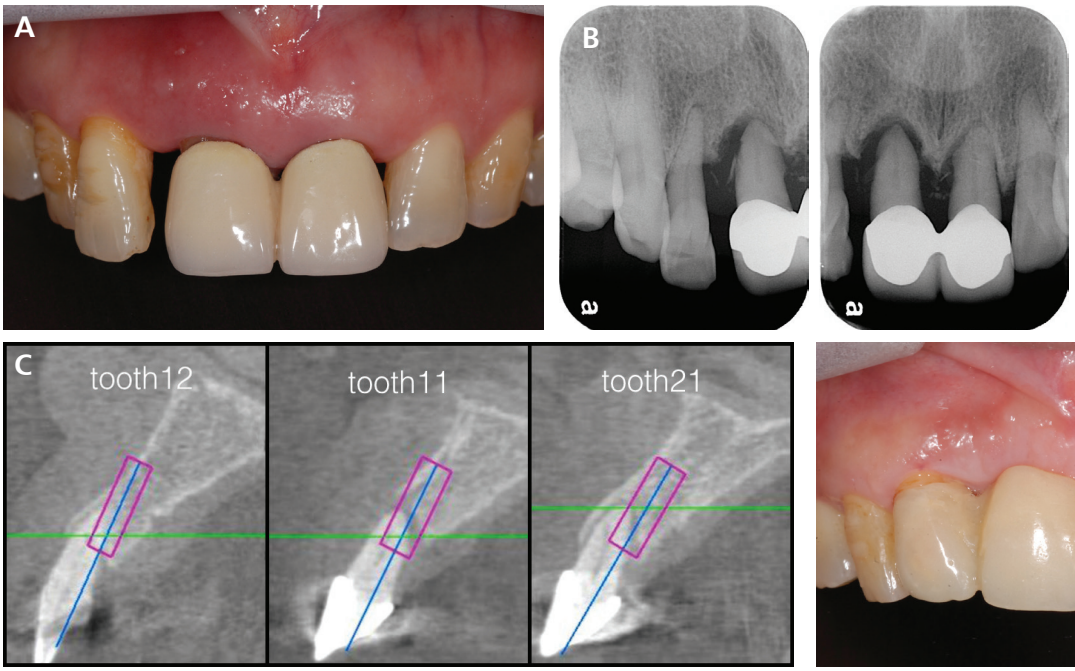

Figure 6. (a) Initial condition with illl-fitting splinted crowns on maxillary bilateral central incisors. (b) Periapical film showed severe periodontal destruction. (c) CT image showed insufficient labial bone width.

Figure 7. Delivery of provisional FDPs after maxillary right central incisor extracted.

(Fig. 4). There were no biological or mechanical complications at the 3-year follow-up visit (Fig. 5).

Case 2:

A 66-year-old woman came for help due to pain and poor esthetic appearance. After comprehensively clinical and radiographic examinations (Fig. 6), there were ill-fitting splinted crowns of maxillary bilateral central incisors with a large space between maxillary right central and lateral incisors. Extraction of all the three teeth was indicated due to severe periodontal bone loss. However, patient didn't want to wear removable prothesis because of compromised esthetics and discomfort. Therefore, IIPP was a preferable choice, but there was insufficient bone width in the CT images for immediate implant placement. To improve the preexisting tissue condition before IIPP, serial tooth extraction was a strategic method. Maxillary right central incisor was removed first, and a three-unit provisional fixed dental prostheses (FDPs) retained by maxillary right lateral incisor and left central incisor was delivered (Fig. 7). Then, guided tissue regeneration was performed on maxillary right lateral incisor and left central incisor combined with guided bone regeneration on the edentulous ridge of maxillary right central incisor with xenograft (Bio-OSS, Geistlich) and resorbable collagen membrane (EZ Cure, Biomatlante) (Fig. 8).

After 8 months for hard and soft tissue healing, maxillary right lateral incisor and left central incisor was extracted atraumatically, and two implants (OsseoSpeed™ TX, 3.5×13mm for right lateral incisor and 4.0×13mm for left central incisor,

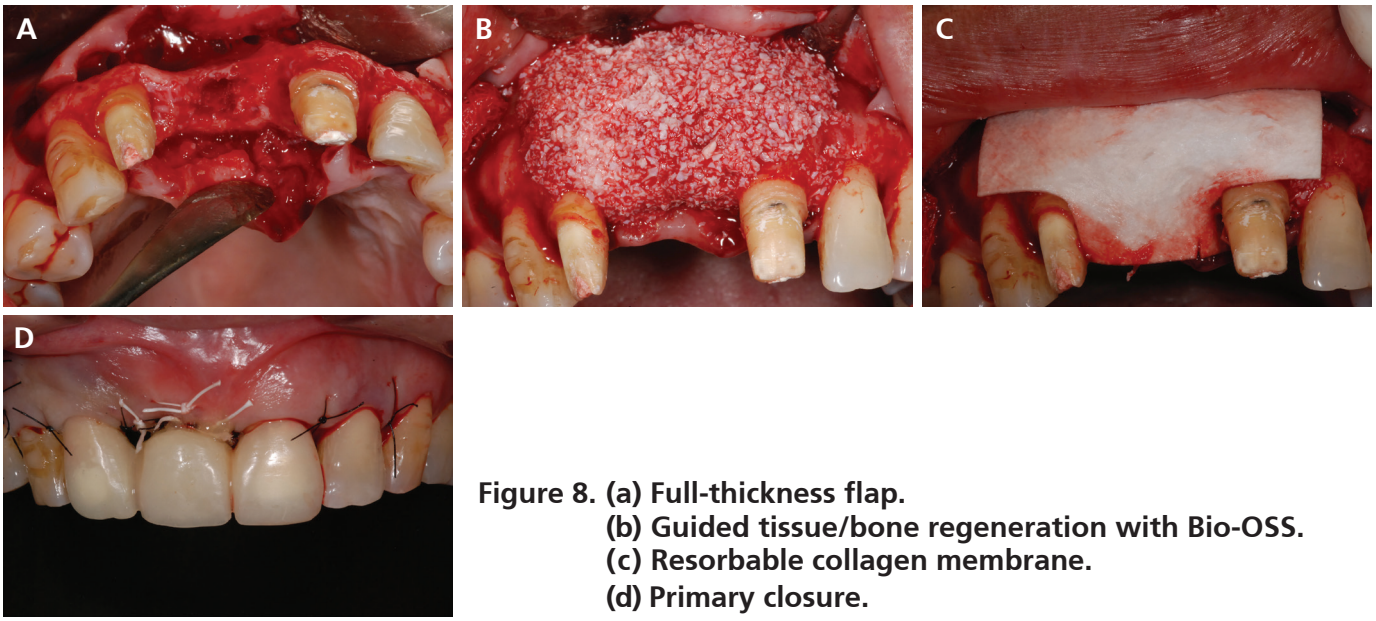

Figure 8. (a) Full-thickness flap.
(b) Guided tissue/bone regeneration with Bio-OSS.
(c) Resorbable collagen membrane.
(d) Primary closure.

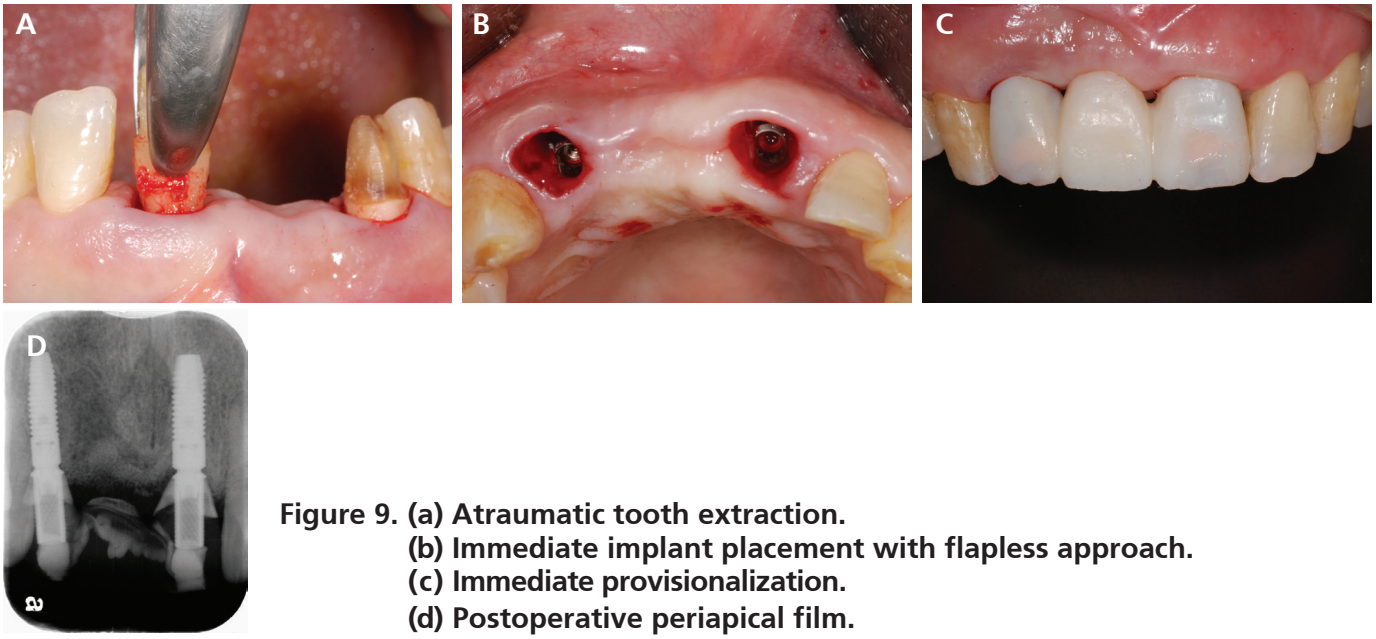

Figure 9. (a) Atraumatic tooth extraction.
(b) Immediate implant placement with flapless approach.
(c) Immediate provisionalization.
(d) Postoperative periapical film.

Figure 10. Insertion of definitive screw-retained implant-supported FDPs.

Figure 11. Four-year follow up.

Astra Tech) were inserted immediately with primary stability of ≥30 Ncm^2 by using flapless approach. Auto-polymerized bisacrylic composite resin (Protemp 3 Garant; 3M ESPE) and titanium temporary abutments (Temp Abutment TX, Astra Tech) were used to make the screw-retained provisional FDPs. Then, the gaps between the implants and labial bone plates were filled with bone grafts (FDBA, LifeNet) after insertion of the implant-supported provisional FDPs. Occlusal adjustment was done to ensure neither centric nor eccentric occlusal contact (Fig. 9).

After 3 months of osseointegration, final impression was made by using splinted customized impression copings and polyvinyl siloxane (Aquasil Ultra XLV and Aquasil Soft Putty; Dentsply Caulk), and the definitive screw-retained implant-supported FDPs with porcelain-fused-to-zirconia design (Ceramill Zi, Amann Girrbach AG; veneer porcelain: Vita VM9) was delivered[13-15]. The outcome with harmonious gingival level and adequate papilla height was achieved in this case (Fig. 10). There were no biological or mechanical complications at the 4-year follow-up visit (Fig. 11).

Discussion

IIPP in the anterior maxilla was advocated with advantages including social and psychological issues (shorter treatment time), function (correct placement permitting axial loads) and esthetics (tissue preservation). In these two cases, the pre-existing tissue condition and primary stability were critical problems for IIPP. Because of the infected tissue and severely periodontal bony destruction, both cases were unable to achieve enough primary implant stability, and were contra-indicated for IIPP. When a clinician encounters a case with such a poor soft and hard tissue condition, the early or delayed implant placement protocol may be the more reasonable option. But it will take a long time and cost to rebuild the residual ridge with tremendous soft and hard tissue resorption following infected tooth extraction[16,17]. Surgeons would usually perform techniques, such as ridge preservation with guided bone regeneration and soft tissue graft, to achieve esthetic and functional outcomes. But there is still in dilemma for both patient and clinician. Even though there had been reported reliable reconstruction outcomes and success rates[18], the technically sensitive procedures and time-consuming healing period were also the problems to clinicians. Moreover, patient needs to endure unesthetic appearance and uncomfortable experience with denture or even no provisional prosthesis during a long healing period.

In the first case, the apical surgery and guided bone regeneration was strategically performed first to eliminate infection source from maxillary left central incisor and rebuilt apical hard tissue for adequate primary stability for IIPP. Moreover, patient can keep her esthetic appearance during a long healing period without a removable denture. In the second case, the serial tooth extraction and guided tissue/bone regeneration was combined to improve the pre-existing tissue condition. There were some obvious benefits from serial tooth extraction procedure, such as preventing severe soft and hard tissue collapse, and being able to keep provisional FDPs for maintaining esthetics and occlusal function during soft and hard tissue healing after surgical reconstruction. Moreover, the inter-proximal bone crest and papillae could be preserved in such a case with multiple adjacent missing teeth. The patient might be needed for a more complicated and numerous guided bone regeneration and soft tissue graft, if early or delayed implant placement protocol was implemented, which might also lead to an unpredictable esthetic outcome by losing papilla eventually.

In summary, these two cases were presented in patients with maxillary anterior teeth extracted and planned for IIPP for better esthetics by changing the sequence of tooth extraction and the timing of surgical reconstruction to make the ideal pre-existing tissue conditions. It showed not only esthetic appearance and patient's comfort increased, but also the number of operation times reduced. However, careful case selection, accurate diagnosis and clear communication between the clinicians and patients are the success keys for the esthetic outcome. The patient with in-cooperate psychological status, poor oral hygiene maintenance, existed tremendous hard and soft tissue destruction, and the dental infected source which cannot be eliminated were contra-indication to this treatment application. More researches are needed for better understanding these application aspects and the long-term success rates.

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Case Report

Full mouth rehabilitation with All-On-4 concept-A case Report

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Abstract

The success and surgical complexity of endosteal dental implants are significantly affected by re-sidual bone volume. However, compromised patient conditions such as poor quality of bone and patient's request for short treatment time both are common clinical problems. The following case report describes a case of a 57 year-old female patient with history of severe periodontitis in re-quired of fixed implant restorations. The patient's maximum residual bone height in the posterior mandibular is less than 4mm and there was also severe bone resorption over upper anterior region. In this case, considering its indication for patients with severe bone resorption, the All-on-4 concept was selected as the treatment procedure which can also improve the patient's appearance and chew-ing function.

Key words: tilting implant

Introduction

Nowadays, implant therapy has demonstrated high success rate and its treatment outcome are be-ing accepted by majority of patients. However, anatomic defect of residual alveolar ridge, which may be caused by trauma, periodontitis or sinus pneumatization over maxilla, may complicate the treatment plan and prolong the treatment time. In such cases, patients with severely resorbed bony defect need to go through substantial grafting procedures which may take 6 months or longer to re-construct implant sites[1].

The All-on-4 concept[2,3] (Nobel Biocare AB,Goteberg,Sweden) is a method that full-arch fixed im-plant reconstruction supported by only 4 implants, which has the biomechanical advantage of oc-clusal stress distribution on distal cantilever arm and also increases Anteroposterior spread(A-P spread). This method advocates two anterior straight, regular-size implants and two posterior tilting ones both placed in an angle ranged from 30 to 45 degree. Angled multi-unit abutments are used to correct implants angulation and rigid supra-structure to splint four implants in full-arch reconstruc-tion. In Malo's clinical studies up to 10 years follow-up, 98.1% implant-related survival rate and 92.8% implant survival rates for immediate loading were reported[2,3,4]. However, questions remain with respect to the amount of stress generated at the peri-implant bone surrounding tilted implants which may cause peri-implant bone loss.

With two tilting implants over severe ridge resorption posterior region can avoid complex ridge augmentation procedure like sinus

elevation and increase A-P spread of implants[5,6]. In the finite el-ement analysis study by Bevilacqua et al., they compared the vertical and 15-degree implant maximum stress values in compact bone with 150 N vertical load were 10.6 MPa for vertical implant and 18.9 MPa for 15-degree, 20.2 MPa for 30-degree angulation 25.0 MPa for 45-degree inclination. It seems that tilting single implants increase peri-implant bone stress compared to straight single implant[6].

Design of distal tilted implants, splinted with rigid fixed denture over 150 N vertical load-ing, the stress level of the distal implants were -12.9% for 15-degree angulation, -47.5% for 30-degree angulation, and -73.5% for 45-degree angulation[6]. From 5 years follow up clinical result showed that the cumulative success rate were 98% for tilted implants and 93% for non-tilted implants[2,5].

Cantilever design is also a problem because of its poor stress distribution over implants and abutments. In the study by Rubo et al[7] demonstrated that the increase in stress on implants was proportional to increased cantilever lengths. The investigation from Krek-manov et al. showed that distal implants tilted 45 degrees distally (distalization of the implant restorative platform) resulted in reductions of distal cantilevers up to 10 mm, when compared with the use of vertical implants and the load distribution result showed no sig-nificant difference between tilted and the non-tilted implants. Therefore, splinting tilted implants to reduce cantilever length is likely one of the treatment options to patients with compromised ridge condition.

The following full mouth rehabilitation report describes a case of "All-on-4 treatment con-cept", implant-supported fixed denture with minimum cantilever extension. Surgical guide was designed with the CT scan and EXOCAD software to simulate the implant position.

Case report

The healthy 57-year-old female presented with generalized severe chronic periodontitis and max-illary ill-fitting prostheses. The patient required a fixed restorative option which meet such criteria of non-interference of regular life and improve her appearance and chewing function. The patient had advanced alveolar bony destruction over anterior region in both arches and less than 4mm residual bone height over posterior region. (Fig.1) First treatment option is staged approach and eight implant placement in maxilla and six implant placement in mandible which has more implant support but takes longer treatment period and fee. The other is "All-on-4 treatment concept" which can shorten treatment time and less cost but more biomechanic complication. After discussion, she chose the "All-on-4 treatment concept" for her full mouth rehabilitation.

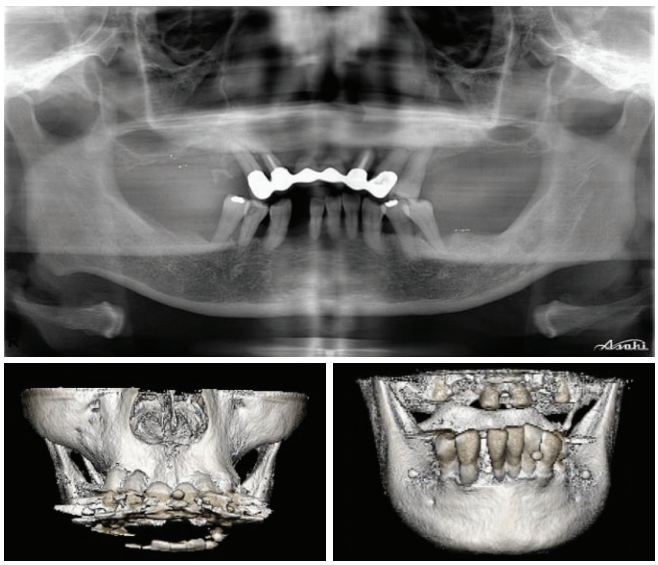

Figure 1. Panoramic radiograph and CT scan.

First, upper and lower anterior teeth were extracted in one appointment and then removable imme-diate denture was provided to rehabilitate her appearance and function. Lower premolar and canine were preserved for better removable denture stability and anchorage for surgical stent. According to the outline of removable immediate denture, CBCT scan (3DeXam, Kavo) with an image guide was performed for implant surgical design.(Fig.2) During the surgery, two straight implants and two 30-degree tilting implants (I55™ implants, AB Dental Devices, Ashdod, Israel) were placed over up-per and lower arch inter-foramina area with surgical template and anchorage pins. (Fig.3) Angled abutments were placed during the surgery to verify the angulation of implants in the same arch. Af-ter eight months postoperative healing, all implants were osseointegrated according to radiographic examination and clinical charting[8]. Temporary cylinders were placed at implants and were connected to the immediate dentures, which were then modified as interim fixed implant prostheses. (Fig.4) Patient had good feedback to her new fixed implant prostheses in terms of esthetics and function. Six-months after interim prosthesis delivery, upper and lower

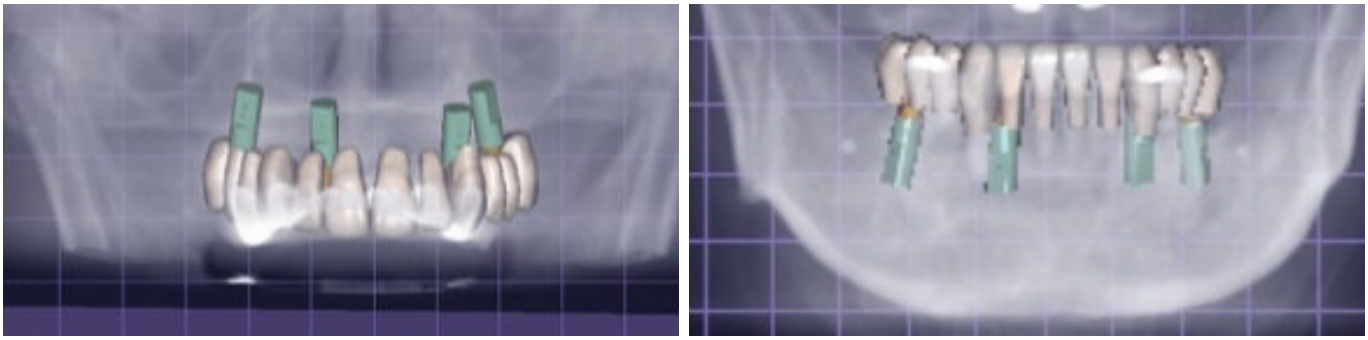

Figure 2. Surgical guide design with EXOCAD.

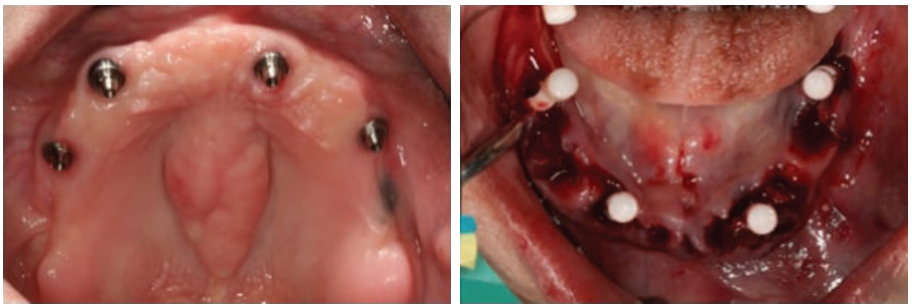

Figure 3. Implant placement and angulation.

Figure 4. Provisional Intraoral view.

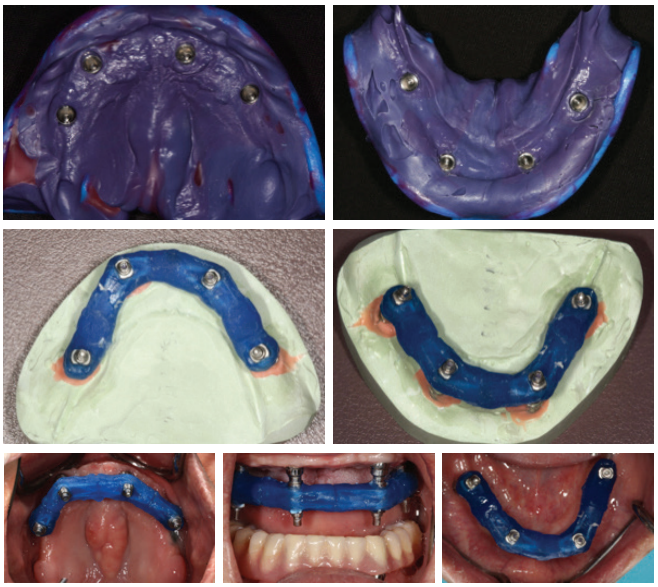

Figure 5. (Upper) Master cast and (Lower) Verification jig.

implant abutment level polyether im-pressions were taken (3M ESPE Impregum Penta™ soft) with splinted impression cylinders.(Fig.5) The accuracy of the master casts were examined by verification jig placing on implants with one-screw test[9,10]. Both of the master casts were proven to be accurate. Then the interim fixed prostheses were placed on the master casts and casts were mounted on an articulator(Artex, Amann Girr-bach).(Fig.6) Putty matrix was made to record the interim occlusal setup as definitive denture teeth setup. (SR Orthosit PE, Ivoclar Vivadent)(Fig.7) During the clinical try-in, patient was satisfied with the esthetic of new prostheses.(Fig.8) Both the master casts and teeth arrangement were then digitally scan. Framework was designed as a 4x4 mm titanium milling bar and at least 2mm acrylic resin thickness was provided to attach denture teeth. The frameworks were milled as alumina replica for try-in first and checked with radiographs. (Fig.9) Definitive titanium frameworks were milled and denture teeth were arranged on them. After final wax-denture try-in and processing, the defini-tive prosthesis were delivered to the patient.(Fig.10) Recall checkups were done to verify occlusal condition, oral hygiene maintenance and structure integrity every 3 months.

Figure 6. Master cast mounting by provisional.

Figure 7. Denture teeth arrangement with use of putty matrix.

Figure 8. Wax denture Try-in.

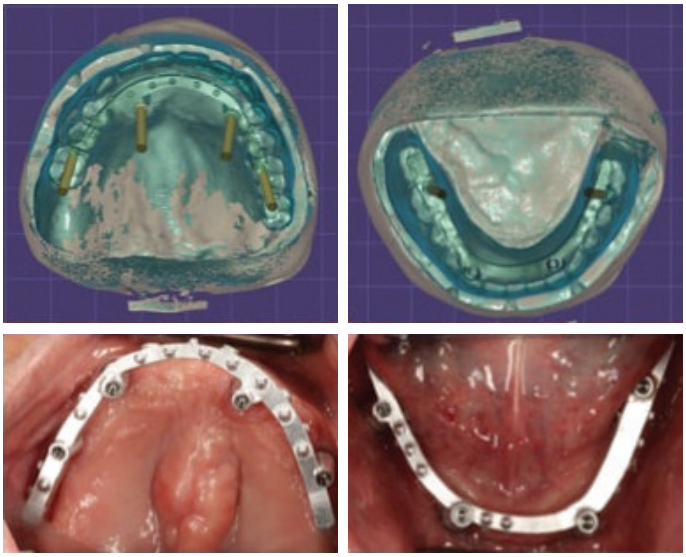

Figure 9. Aluminum replica radiograph(Left) Framework design and aluminum replica try-in (Right).

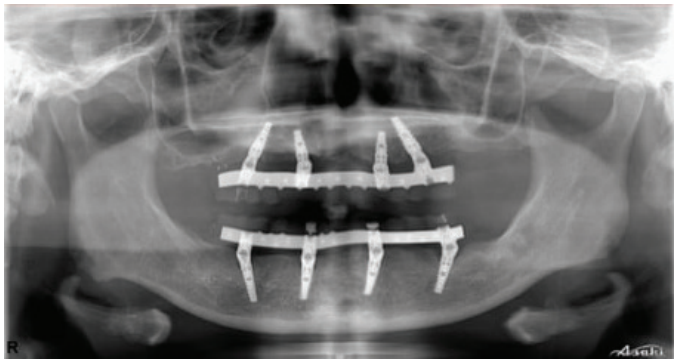

Figure 10. Final Radiograph(Left) Definitive Prosthesis(Right).

Discussion

The superstructure of implant supported fixed partial denture has two common designs: metal-ceramic fixed bridge and metal–acrylic resin complete implant supported fixed partial den-ture(ISFPD). There was no systematic study directly compared the incidence of prosthodontics complications between two kinds of design. From the viewpoint of technical complication, metal-acrylic resin ISFPD had more veneer chipping rate than metal-ceramic ISFPD in 15 years follow up. However veneer fractures may be caused by insufficient material thickness, design issues or technical errors[5,11]. In our case, the superstructures were consisted by metal framework and acrylic resin. There were two reasons to support the design idea. First, in the condition of excessive inter-arch restoration space, constructing with metal-ceramic prosthesis may cause high incidence of casting distortion and high laboratory fee. Second, repaired acrylic resin is easier than ceramic res-toration in full-arch complex design.

In this case, using provisional prosthesis for jaw relationship registration is more convenient and reliable than traditional method by using wax rim and record base. The provisional which were used for more than 6 months can offer direct patient information such as occlusal plane, incisal edge position, flange extension and occlusal guidance. With this information, the technician can easily process the definitive prosthesis and time efficient for dentist to proceed clinical adjustments.

Conclusion

With severe residual ridge resorption, full arch implant rehabilitation is challenging. One should consider simplifying the treatment procedure to meet the current esthetic dental standards and pa-tient expectation. The All-on-4 concept satisfies patient's need in this case. By using tilted distal implant and hybrid prosthetic design, patients didn't go through complicated bone augmentation and multiple implants surgeries. It is also much simpler for a clinician to communicate with labora-tory technicians for the fabrication of framework and prosthesis which was used to be time-consuming. In this case, a successful full mouth rehabilitation with the All-on-4 concept was demonstrated. There were no complications in the one-year recall.

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Journal of Prosthodontics and Implantology

Introduction for authors

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5. 請同時附上致本誌主編簡短信函，表明投稿本誌之意願，並說明所有著者均曾過目並簽名同意。若為人體試驗須附人體試驗委員會之同意函。

四、 稿件內容詳細規格如下:

1. 首頁 (title page)：包括題目、作者姓名、服務單位、學歷；英文簡題(running title)長度在四十個字以內；稿件主要負責者(corresponding author)之英文姓名與地址、電話、傳真、e-mail。
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      (1) 前言 (introduction)：簡要說明研究由來。
      (2) 材料與方法 (material and methods)：敘述研究設計、對象、步驟。
      (3) 結果 (results)：研究結果以文字、表格或插圖表示之。
      (4) 討論 (discussion)：強調重要結果與論點，與前人論述作比較等。
      (5) 結論 (conclusion)：結論要簡要明確。
   C. 技術報告 (technical report) ー 分前言、方法描述、討論。
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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; 8:78-85. Available at: http://www.thejedp.com/issue036/index.htm. Accessed November 20, 2007.

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