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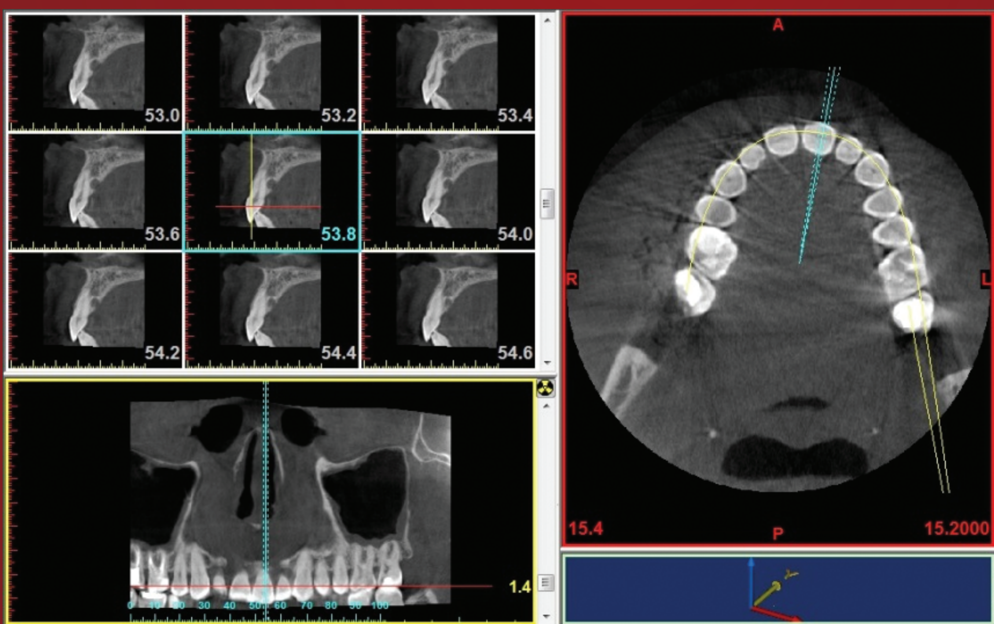
Journal of Prosthodontics and Implantology



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Journal of Prosthodontics and Implantology

Editorial

In 2024, we are witnessing a year marked by emotional reconnection and intelligent impact. Following the rapid development of the COVID epidemic, there has been a heightened awareness of stress, a greater appreciation for the environment, a shift towards a slower pace of life, and a renewed emphasis on community connections and artificial intelligence.

Amid this backdrop, the September 2024 issue of the Journal of Prosthodontics and Implantology features two original articles and two case reports. The first original article, a study using CBCT to measure the collum angle of maxillary central and lateral incisors in Taiwanese individuals, provides valuable insights for orthodontics and prosthodontics, particularly in anterior restorations. The second original article is a 6-year prospective cohort study on monolithic lithium disilicate for posterior implant restorations, detailing the technical complications and failure rates observed.

Additionally, this issue includes two case reports. One explores the innovative application of a CAD/CAM reduction guide, while the other presents a comprehensive full-mouth rehabilitation case. These contributions keep our readers abreast of the latest advancements in full-mouth rehabilitation techniques.

We hope you enjoy the academic and clinical discussions presented in this issue. Our team is dedicated to maintaining the highest standards of quality in our content. We welcome feedback and suggestions from our readers to help us adapt to the dynamic field of prosthodontics in Taiwan.

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

Li-Deh Lin

Li-Deh Lin, Editor-in-Chief

Original Article

Cone beam computed tomography measurement of the collum angle of maxillary central and lateral incisors in Taiwanese individuals

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Running title: the collum angle of maxillary central and lateral incisors

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Abstract

Aims: *The crown positioning of anterior teeth directly impacts facial aesthetics. However, crown position is affected by the angle between the crown and the root of the tooth; therefore, this angle must be specifically evaluated before orthodontic and prosthodontic treatment to achieve aesthetically pleasing and functional therapeutic results. To ensure good aesthetics and effective cutting function of maxillary central and lateral incisors, the anterior region should be torqued during orthodontic treatment. Moreover, bone grafting or a cement-retained implant prosthesis is required during implant treatment.*

Materials and Methods: *We obtained cone beam computed tomography (CBCT) images of patients from the China Medical University Hospital Department of Dentistry and measured their collum angles using MIMICS 15.0 software. We selected 19 patients with Class I and 42 patients with Class II, division 1 (Class II/1) occlusal relationships, based on Angle's classification, for comparison. The patients were aged 6–66 years (mean: 26.5 years). The correlation between collum angle and the right and left sides or occlusal classification was determined.*

Results: *No significant difference was observed in collum angle between Class I or II/1 left and right central incisors or between left and right lateral incisors (paired t-test $p > 0.05$). Although no significant difference was observed in collum angle between Class I central and lateral incisors, a significant difference was observed between Class II/1 central and lateral incisors. No significant difference in collum angle was observed between Class I and Class II/1 central incisors, but a significant difference was observed between Class I and Class II/1 lateral incisors (Student's t-test, $p = 0.04$).*

Conclusion: *In both orthodontic and prosthodontic treatment, more attention should be paid to collum angle size, especially that of the lateral incisors, to ensure the preservation of a safe space during the treatment process to avoid irreversible injuries.*

Key words: cone beam computed tomography, collum angle, maxillary central incisors, maxillary lateral incisors

Introduction

The collum angle, which is the angle formed by the long axis of the crown and the root of the tooth, is of critical aesthetic importance in orthodontics and prosthodontics.[1] The angle may limit the extent to which the root can be torqued to the lingual cortical plate, the angle at which implants can be placed, or how prostheses are secured. For patients needing to undergo such orthodontic treatments, the dentist must be careful about the degree of palatal torque to avoid impinging on the cortical palatal bone, which could result in irreversible root resorption. The collum angle of the maxillary central incisor is significantly different between Angle's classification Class II/1 and Class II, division 2 (Class II/2).[2,3] Previous studies have found no significant difference in maxillary central incisors between the right and the left side,[4] between different races,[5,6] between males and females, and between different age groups,[7] but inter-individual differences between labial crown morphology and the collum angle of maxillary anterior teeth can be large.[8] There is no consistency in the associations between collum angle and different skeletal relationships[7,9] and apical root resorption before or after comprehensive orthodontics.[10]

In orthodontics, torque is used for labiolingual or buccolingual tilting of the teeth. A large collum angle is often observed in some patients with deep overbites[11] and Class II/2, Class II/1, or Class III malocclusions.[12] The clinical significance of this study is its attempt to increase awareness of the collum angle during orthodontic and prosthodontic treatment, especially in cases of teeth with large angles that need to be torqued in order to avoid root contact with the cortical plate and perforation of the alveolar bone on the buccal side. Patients with missing teeth that require implants have large collum angles, and the angle between the implant and the abutment teeth may be excessively large. In such cases, abutment teeth with an appropriate angle may be necessary to create aesthetically pleasing prostheses. In addition, inappropriate implant placement may cause gingival recession by concentrating stress on the alveolar bone on the buccal side of the implant, thus affecting aesthetics.

This study explored whether there were differences in the collum angle between maxillary central incisors and lateral incisors in patients with Class I or Class II/1 occlusal patterns.

Material & methods

This study was approved by the Institutional Review Board (CMUH 108-REC2-083). Cone beam computed tomography (CBCT) images of 33 female and 28 male patients aged 6–66 years (mean: 26.5 years; median: 24 years; mode: 21 and 27 years) were obtained from the Department of Dentistry of China Medical University Hospital. The inclusion and exclusion criteria were as described by Khalid et al.[7] Our inclusion criteria were clear visibility of roots and crowns on CBCT images, the absence of orthodontic appliances in the patient, and the absence of craniofacial syndromes. The exclusion criteria were the presence of fractured anterior teeth and fabricated dentures.

Based on Angle's classification, 19 patients were classified with a Class I occlusal pattern and 42 patients with a Class II/1 occlusal pattern. CBCT images were imported into and opened in MIMICS 15.0 software (Materialise, Leuven, Belgium) for obtaining measurements of the maxillary central and lateral incisors on the left and right sides. As CBCT produces multiplanar reconstructed images, any suitable section could be selected for measurement. When searching for a suitable section, the primary focus was to identify a clear cementoenamel junction CEJ(Figure 1). The collum angle is formed by the long axis of the crown and the long axis of the root apex and is defined as 0°

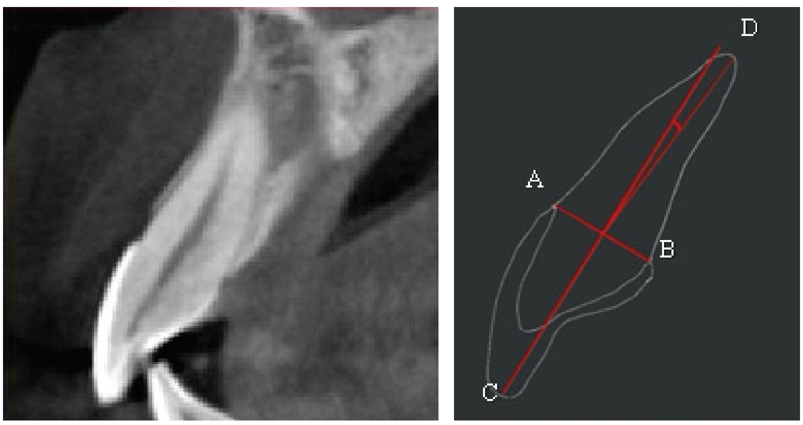

Figure 1. A screenshot of the research method using MIMICS 15.0 software image (left). Collum angle of the central incisor of the upper jaw (right). A: Facial CEJ; B: palatal CEJ; C: incisor edge; D: root apex (self-drawn schematic diagram).

when the two lines coincide. When the long axis of the root is on the lingual side of the long axis of the crown, the collum angle is defined as positive. When the long axis of the root is on the labial side of the long axis of the crown, the collum angle is defined as negative (Figure 2). In the present study, the collum angle of the central and lateral incisors of all cases was measured by a trained specialist using the same method. IBM SPSS Statistics for Windows, version 19 (IBM Corp., Armonk, NY, USA) was used to perform Student's t-test to determine whether the relationship between the angle and tooth laterality and occlusal classification was significantly different.

Step 1: CBCT images were imported into Mimics 15.0, and cross-sections were obtained. Then, the interface was scrolled to display the clear section of the upper row of teeth; the incisors were resliced to obtain a cross-section of the teeth (Figure 3). As CBCT data are multiplanar reconstructed images, oblique sections can be used for more accurate measurement of the collum angle.

Step 2: The maximum width of the bone and enamel in the cross-section was identified, and a line was drawn connecting the root and crown of the tooth through the midpoint of the maximum width of the bone and enamel.

1. Segment 1: The widest part of the bone and enamel was drawn, and the midpoint (M) was identified.
2. Segment 2: The most apical point of the root was located and the midpoint was connected to it.
3. Segment 3: The incisal end of the crown was located, and the line was extended through the midpoint.

The angle formed by line segments 2 and 3 was defined as the collum angle (Figure 4).

Step 3: IBM SPSS Statistics for Windows, version 19 (IBM Corp.) was used for paired t-tests of the collum angle of the left and right central and lateral incisors and the collum angle of the maxillary central and lateral incisors in cases of Class I and Class II/1 malocclusion.

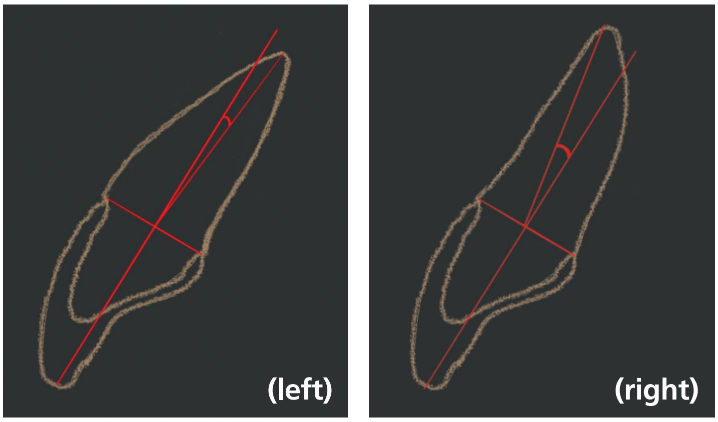

Figure 2. Schematic diagram showing positive collum angle (left) and negative collum angle (right).

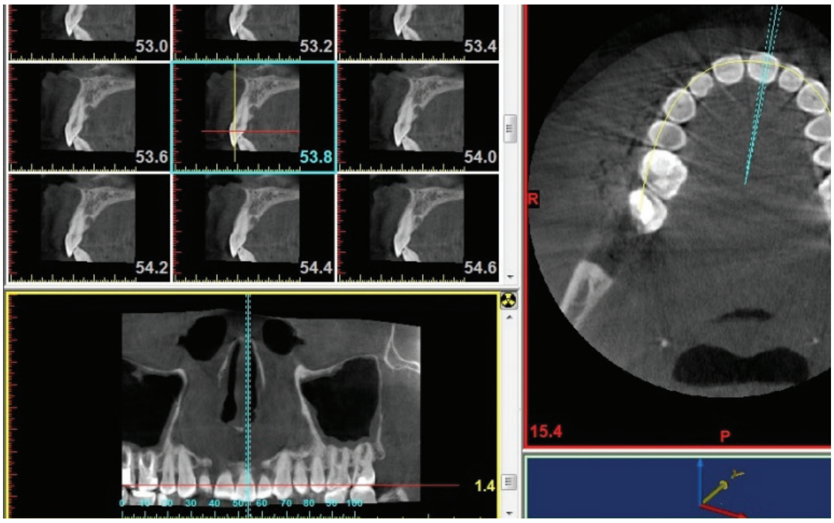

Figure 3. Cross-sectional view of the maxillary central incisor.

Figure 4. Steps for measuring collum angle.

Results

TIn this study, the lateral incisors were measured in addition to the central incisors to determine whether a correlation existed between the collum angles of the left and right central and lateral incisors and occlusal classification. The central and lateral incisor angles were evaluated for significant differences between the left and right sides and between different occlusal relationships. Column angle did not differ significantly between the left and right sides, irrespective of sex. Moreover, no significant differences were observed for either Class I or Class II/1 left central incisors vs. right central incisors or left lateral incisors vs. right lateral incisors (paired t-test, $p > 0.05$; Tables 1 and 2).

As no statistically significant difference between the left and right sides was identified, the two sides were pooled, and the central incisors were compared with the lateral incisors. No significant difference was observed in collum angle between the central incisors and lateral incisors for Class I, but a significant difference between the central incisors and lateral incisors was observed for Class II/1 (Tables 3 and 4).

Data from the left and right sides were pooled for Student's t-test analysis. Collum angle did not differ significantly between Class I and Class II/1 central incisors ($p = 0.487$), but a significant difference was observed between Class I and Class II/1 lateral incisors ($p = 0.04$; Tables 5 and 6).

Table 1. Comparison of collum angle of maxillary central incisor and lateral incisor of Class I patients (the right and left sides were not pooled).

	Central incisor (L)	Central incisor (R)	Lateral incisor (L)	Lateral incisor (R)
MEAN (degree)	-0.66	-2.40	1.24	-1.52
SD (degree)	4.99	5.56	8.15	9.28

Central incisor L vs R, P value= 0.078 ; Lateral incisor L vs R, P value= 0.1811

Table 2. Comparison of collum angle of maxillary central incisor and lateral incisor of Class II, division 1 (Class II/1) patients (the right and left sides were not pooled).

	Central incisor (L)	Central incisor (R)	Lateral incisor (L)	Lateral incisor (R)
MEAN (degree)	0.14	-1.38	3.25	2.98
SD (degree)	5.97	6.58	5.81	6.39

Central incisor L vs R, P value= 0.340 ; Lateral incisor L vs R, P value= 0.481

Table 3. Comparison of collum angle of maxillary central incisor and lateral incisor of Class I patients (the right and left sides were pooled).

	Central incisor	Lateral incisor
MEAN (degree)	-1.50	-0.09
SD (degree)	5.35	8.82

Central incisor vs Lateral incisor, P value= 0.437

Table 4. Comparison of collum angle of maxillary central incisor and lateral incisor of Class II, division 1 (Class II/1) patients (the right and left sides were pooled).

	Central incisor	Lateral incisor
MEAN (degree)	-0.64	3.12
SD (degree)	6.33	6.10

Central incisor vs Lateral incisor, P value= 0.0003

Table 5. Comparison of collum angle of maxillary central incisor of Class I and Class II, division 1 (Class II/1) patients.

	Mean	SD
Class I (degree)	-1.50	5.35
Class II/1 (degree)	-0.64	6.33

Class I vs Class II/1, P value=0.487

Table 6. Comparison of collum angle of maxillary lateral incisor of Class I and Class II, division 1 (Class II/1) patients.

	Mean	SD
Class I (degree)	-0.09	8.82
Class II/1 (degree)	3.12	6.10

Class I vs Class II/1, P value=0.041

Discussion

The results of this study showed that the collum angle of the lateral incisor of the Class II/1 malocclusion group was significantly different from that of the Class I malocclusion group. Although the source of the image samples measured in this study is different from those of previous studies of orthodontic patients, the results for the upper central incisor in this study are consistent with the trend of other CBCT measurements of collum angle (Table 7). Although malocclusion was classified in different ways in previous studies, a systematic review and meta-analysis proposed pooling data obtained from lateral cranial radiographs and CBCT.[13] Compared to previous studies, collum angle values measured using CBCT were smaller (Table 7). In addition, the results for the upper central incisor in this study showed negative values unlike previous studies. We inferred that this may have been due to the influence of image sample sources that included patients from outside orthodontic departments.

Root resorption is the most undesirable occurrence in orthodontic treatment. For some patients with large collum angles, the amount of torque applied must be carefully controlled to avoid irreversible root resorption. In previous reports, the duration of orthodontic treatment and extraction was positively correlated with orthodontic treatment-induced inflammatory external apical root resorption ($p < 0.05$), which was most common in maxillary incisors. The incidence of severe root resorption after orthodontic treatment was 14.8%, with males having a higher incidence of root resorption than females.[14] Some researchers have raised reasonable concerns that palatal torquing of central incisor roots in Class II/2 patients may cause the roots to strike the palatal cortical bone, resulting in root resorption of the associated teeth.[15] The mean collum angle observed in Class II/2 cases was significantly larger (5.2° ± 1.3°) than the mean of Class I or Class II/1 cases (0.1° ± 0.7 °), suggesting that patients with morphometric features associated with large collum angles require better tooth movement planning, especially for palatal torque of the maxillary central incisors.[15]

A systematic review and meta-analysis reported that the collum angles of 4.7° in Class II/2 and 2.0° in Class III were larger than those in Class I. Most previous studies evaluated the collum angle of the maxillary central incisors in Class II/2 cases, with 13 of 17 articles using lateral cephalograms for measurement.[13] Studies on the collum angle of lateral incisors in Taiwanese individuals are rare. The results of this study demonstrated that the long axis of the root in both Class I and Class II/1 cases was located on the labial side of the long axis of the crown, and the collum angle of Class I was greater than that of Class II/1 based on quantitative CBCT images. In addition, changes in the lower lip line may have an etiological role in the development of collum angle.[16] Therefore, more samples must be collected to further evaluate

Table 7. Comparison of results for maxillary central incisor of this study with those of previous studies.

year of publication		This study	2012	2018	2019	2020	2021
author			Shen[1]	Feres[15]	Wang[9]	Khalid[7]	Panezai[16]
Method		CBCT	lateral cephalometric	CBCT	CBCT	lateral cephalograms	lateral cephalograms
Sample size	Class I	19	33	16	24	25	---
	Class II/1	42	32	16	20	25	70
Collum angle of maxillary central incisor (degree)	Class I	-1.5(5.3)	6.1(5.2)	1.1(4.2)	–1.02(6.30)	5.12(3.78)	not applicable
	Class II/1	-0.64(6.33)	5.3(4.2)	0.1(0.7)	5.18(4.97)	6.10(4.58)	4.38(3.08)
Gender	Male	28	38	12	26	31	66
	Female	33	86	20	40	69	74
Age range		6-66	8-58	---	18-30	10-50	---
Average age		26.5	19.9	18.25±0.56 16.91±0.62	25.8	15.9	21.62 ± 5.96
Sample source		All clinical patient	for clinical orthodontic needs	Orthodontic Graduate Program records	for clinical orthodontic needs	from the Department of Orthodontics	Orthodontics department

Class II/1: Class II, division 1

maxillary and mandibular anterior teeth in different occlusal relationships.

Since there are few studies on the collum angle of lateral incisors, these teeth remain one of the most important factors affecting the aesthetics of the anterior region. Successful treatment results are usually achieved when dental implants are placed in the same position as natural teeth.[17] Although the data could not be analyzed by sex due to the small sample size in this study, the results indicated no statistically significant difference in collum angle between the right and left sides of Class I or Class II/1 lateral incisors and a statistically significant difference between Class I and Class II/1 lateral incisors. The preliminary results of this study may provide a reference for dentists when preparing treatment plans.

This study found that the collum angles of the central incisors and lateral incisors of Class I occlusion and the central incisors of Class II/1 occlusion were all negative, and only the lateral incisors of Class II/1 occlusion were positive. Therefore, we infer that when the occlusion relationship is Class II/1, there may be thick alveolar bone on the buccal side of the lateral incisors, which can help to avoid implant perforation when performing dental implant surgery. In addition, because the crown must meet aesthetic and functional requirements, the crown on the dental implant is more likely to be fixed with dental cement when the collum angle is positive. There is an important correlation between buccal bone responses and aesthetic results after dental implant placement. Therefore, the dental implant must have sufficient thickness of alveolar bone on the buccal side, because in a previous study, the middle and apical regions of the implants showed horizontal bone alterations of -0.57 mm and -0.19 mm after one year.[18] Thus, when the collum angle is negative, a bone graft is recommended when the crown on the dental implant is to be fixed with screws. Furthermore, because the application of immediate dental implants has the advantages of less surgery, shorter treatment time, and improved aesthetics, single dental implants, mainly incisors and premolars, are the most common treatment option. In early studies, bony morphology was a very important factor of success when immediate implants were indicated. Situations not suitable for immediate implant placement include periodontal bone loss with two and three walls missing or severe labial and circumferential defects.[19] When performing dental implants, severe labial defects at the implants may be caused if there is failure before treatment to determine whether the collum angle of the upper central or lateral incisor is negative.

A limitation of this study is that all the measurements were obtained from images. Although CBCT is a three-dimensional reconstructed image that provides better resolution, Angle's classification, which is a lateral view of the relationship between the dentition and palatal bones, may itself be a source of bias in classifying patients based on the occlusal relationship. In addition, due to the limited number of samples, this study could not determine whether there was a significant difference in collum angle between males and females.

Conclusions

Preliminary results for maxillary central and lateral incisor measurements based on CBCT images of patients showed that (1) there was no significant difference in the collum angle of the central or lateral incisors between the left and right sides of the upper jaw; (2) there was a significant difference in collum angle between the maxillary lateral incisors of Class I and Class II/1; and (3) the collum angle of the maxillary lateral incisors of Class II/1 was positive.

Acknowledgments

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Original Article

Technical Complication and Failure Rates of Posterior Implant-supported Monolithic Lithium Disilicate Single Crowns: A 6-Year Prospective Cohort Study

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Running title: Prognosis of posterior implant-supported monolithic lithium disilicate single crowns over a follow-up period exceeding 6 years

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Abstract

Aims: *To assess the technical complication and survival rates of posterior implant-supported single crowns (SCs) fabricated with monolithic lithium disilicate (LDS) over an extended period.*

Materials and methods: *A prospective evaluation was conducted on 60 patients with a total of 82 implants undergoing single posterior dental implant restoration. The procedure involved the use of CAD/CAM produced customized titanium abutments and monolithic LDS crowns, with at least 6 years of follow-up. The survival rate and technical complication rate of the implant-supported SCs were analyzed using Kaplan–Meier analysis and Log-Rank tests.*

Results: *The mean observation period was 6.3 ± 0.3 years. The survival rate was 92.5%, along with 2 cases of implant failures and 4 crown fractures. The complication rate was 17.5%, resulting in an overall success rate of 75%. Notably, parafunctional habits were the only variable significantly correlated with both survival and complication rates.*

Conclusions: *Within the limitations of this clinical study, monolithic LDS appeared to be a reliable treatment option for posterior implant-supported SCs based on 6 years of clinical observation. Despite favorable outcomes, a relatively high complication rate, primarily associated with abutment screw loosening (ASL), was noted. Opting for a precise implant-abutment connection from a reputable manufacturer may contribute to improvement. Parafunctional habits were the only variable significantly correlated with clinical outcomes, suggesting the potential benefit of fabricating an occlusal appliance for implant protection.*

Key words: Dental implant, single crowns, monolithic lithium disilicate, complications

Introduction

Dental implant-supported restorations have been widely used for several decades and showcase the significant progress made due to advancements in dental technology and improvements in materials. A recent systematic review and meta-analysis estimated a 10-year survival rate of 96.4% for implants.[1] Due to their high long-term success rate and their predictability, stability, and natural functionality, dental implants are recognized as the standard of care for replacing missing teeth.[1,2]

In addition to the stability of implants, the long-term survival of implant-supported prosthetics is also a crucial concern for dentists. A systematic review by Jung et al. found an estimated five-year survival rate of 96.3% and a 10-year survival rate of 89.4% for implant-supported single crowns (SCs). Technical complications included screw-loosening (8.8% of cases), loss of retention (4.1%), and fracture of veneering material (3.5%) after five years, indicating high survival rates but also frequent complications involving implant reconstructions.[3]

The choice of implant crown material significantly influences the outcomes of implant-supported SCs. Metal–ceramic restorations, a longstanding choice, have demonstrated long-term stability.[4–6] With the advent of computer-aided design and computer-aided manufacturing (CAD-CAM) technology, all-ceramic restorations have gained popularity.[7] Systematic reviews by Pjetursson et al. in 2018 and 2021 highlighted the clinical performance of metal–ceramic, monolithic lithium disilicate (LDS), and monolithic zirconia implant-supported SCs. Metal–ceramic implant-supported SCs had the highest survival estimate (a five-year rate of 98.3%) with the longest mean follow-up period (5.7 years). Monolithic LDS implant-supported SCs had the lowest complication rate (1.7% per year). However, both monolithic LDS and monolithic zirconia implant-supported SCs lacked sufficient observation time.[5,8] Thus, this study evaluated an all-ceramic material, monolithic LDS, used as the crown material for implant-supported SCs for its long-term clinical performance.

In recent years, monolithic LDS has emerged as a promising material for natural tooth-supported SCs. A recent study reported an 80.1% survival rate and a 64.2% success rate after a 15-year follow-up.[9] The combination of strength, aesthetics, and biocompatibility has contributed to its popularity. However, a long-term evaluation of monolithic LDS as an implant restoration material is still lacking. A systematic review and meta-analysis by Rabel K et al. found that monolithic LDS crowns had a five-year survival rate of 91.0%.[10] Another systematic review and meta-analysis by Pjetursson et al. reported a three-year survival rate of 97.0% for monolithic reinforced glass–ceramic implant-supported SCs, with an annual failure rate of 1.05%.[8] In Schubert et al.'s study evaluating 40 implants with one monolithic LDS crown fracture, the overall survival rate was 97.5% over a mean follow-up time of 5.9 ± 1.4 years.[11] Despite the general use of monolithic LDS crowns over an extended period, few studies have addressed the long-term clinical outcomes of implant restorations, particularly in the posterior region.

This investigation aimed to undertake a thorough evaluation of the clinical performance and durability of posterior implant-supported SCs fabricated with monolithic LDS over an extended period. We undertook a longitudinal analysis, with the goal of providing evidence-based guidance to dental practitioners and prosthodontists on selecting the ideal material for posterior implant restorations.

Materials and methods

This study was approved by the Ethics Committee and Institutional Review Board of Chang Gung Memorial Hospital, Taiwan (201700057B0). The study employed a prospective in vivo approach to investigate the long-term performance of monolithic LDS in posterior dental reconstructions, with a follow-up period exceeding six years.

The inclusion criterion for selecting study participants was that they had undergone at least one single-implant restoration in the posterior region between December 2016 and January 2018 at the Prosthodontics Department of Linkou Chang Gung Memorial Hospital. The exclusion criteria were patients who were unable to undergo implant surgery due to general medical conditions or surgical sites with any pathological condition that might compromise treatment outcome and implants with improper angulation that could not be fabricated with a screw-retained implant crown.

A total of 60 patients, comprising 29 males and 31 females with 82 implants, were included in this study. All patients provided written informed consent after they received detailed information about the study objectives. The clinical treatment process involved a minimum three-month waiting period after tooth extraction, followed by delayed implant placements in posterior dental areas by seven periodontists at the Department of Periodontology, Linkou Medical Center, Chang Gung Memorial Hospital, Taoyuan, Taiwan. The implant systems used included Biomet 3i dental implants (Tapered or Parallel-Walled Certain Internal Connection Implants; Biomet 3i, Palm Beach Gardens, FL, USA), Straumann tissue-level (Standard or Standard Plus Implants; Straumann, Basel, Switzerland) and Straumann bone-level (Bone Level implants or Bone-Level Tapered Implants; Straumann, Basel, Switzerland) systems, and XiVE implants (XiVE S Plus implant; DENTSPLY Implants Manufacturing GmbH, Mannheim, Germany). After 3–6 months of healing, these implants were restored by a single prosthodontist (K.H.) at the Department of Prosthodontics in the same hospital. A customized titanium abutment (FIT CAD-CAM custom abutment; FIT MILLING CENTER CO, LTD, Changhua city, Taiwan), fabricated using CAD-CAM procedures, was employed. Subsequently, the final prosthesis, consisting of a monolithic LDS crown, was fabricated using IPS e.max Press (Ivoclar Vivadent AG, Schaan, Liechtenstein) with an occlusal opening to access the abutment screw, and cemented with resin cement (Rely X Unicem or Rely X U200; 3M ESPE, St. Paul, MN, USA). Finally, the assembly was delivered to the patient and tightened with torque according to the manufacturers' instructions. The screw-access hole was filled with polytetrafluoroethylene tape and then with composite resin (Filtek Z350; 3M ESPE, St. Paul, MN, USA) to a depth of at least 1 mm.

The patient records were systematically reviewed. Eight variables were considered: sex, medical history, smoking history, betel nut use, parafunctional habits, date of implant crown delivery, the position of the implant, and the type of implant. A routine follow-up examination was performed at six months, followed by a comprehensive long-term follow-up exceeding six years.

Throughout the prosthodontic examination, technical complications and failures of the implant-supported SCs were assessed by the same examiner (K.H.). Complications included fracture and/or chipping of ceramic that could be managed without impacting occlusal function, causing food impaction, or compromising patient comfort; loosening of an abutment screw; fracture of an abutment screw; and fracture of an abutment. A failure was defined as an event leading to destructive crown fracture necessitating the renewal of the entire implant-supported reconstruction; or explantation/loss of the implant and, consequently, the loss of the implant-supported reconstruction. Survival was defined as reconstructions without failures, while success was defined as reconstructions without both failures and complications.

Descriptive statistics were used for implant analysis and the Kaplan–Meier method was used to analyze the survival rate and technical complication rate. Correlations between survival rate, complication rate, and variables were determined using log-rank tests. The statistical analyses were performed using SPSS software (IBM SPSS Statistics for Mac, Version 29.0; IBM Corp., Armonk, NY, USA). The level of significance was set at $p < 0.05$.

Results

Of the 60 patients (82 implants), one patient (with two implants) was lost to follow-up and could not be contacted by telephone. The 80 examined crowns had an average functioning time of 6.3 ± 0.3 years (range: 6–7.1 years). An overview of the patient variables, implant characteristics, and the influence of these variables on the incidence of failure and complications is summarized in Table 1. Of the 80 implant-supported SCs, 6 implants (7.5%) failed (Fig. 1): 2 reconstructions were lost due to the failure of the supporting implant; and 4 implant crowns suffered destructive fractures, necessitating renewal during the 6-year examination (Table 2). The failure rates for the maxilla (7.9%) and mandible (7.1%) were similar. In the case of complications, 14 reconstructions (17.5%) had at least one issue (Fig. 2). The most frequently observed complication was abutment screw loosening (ASL) (12 cases), followed by one case of ceramic chipping and one case of abutment screw fracture. No abutment complications were observed (Table 3).

As a result, the survival rate of the implant-supported SCs after six years was 92.5% and the complication rate after six years was 17.5%. The success rate after accounting for both failures and complications was 75%. Parafunctional habits were the only variable demonstrating a significant correlation with both the survival rate (log-rank test: $p = 0.035$) and the complication rate (log-rank test: $p = 0.008$).

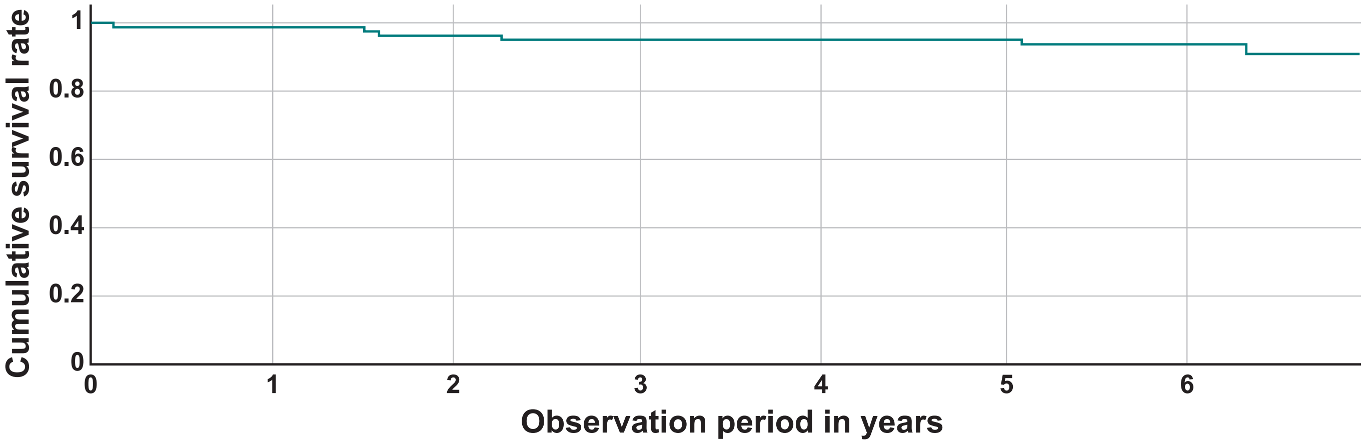

Figure 1. Restoration-based Kaplan–Meier survival function for the failure of implant-supported SCs

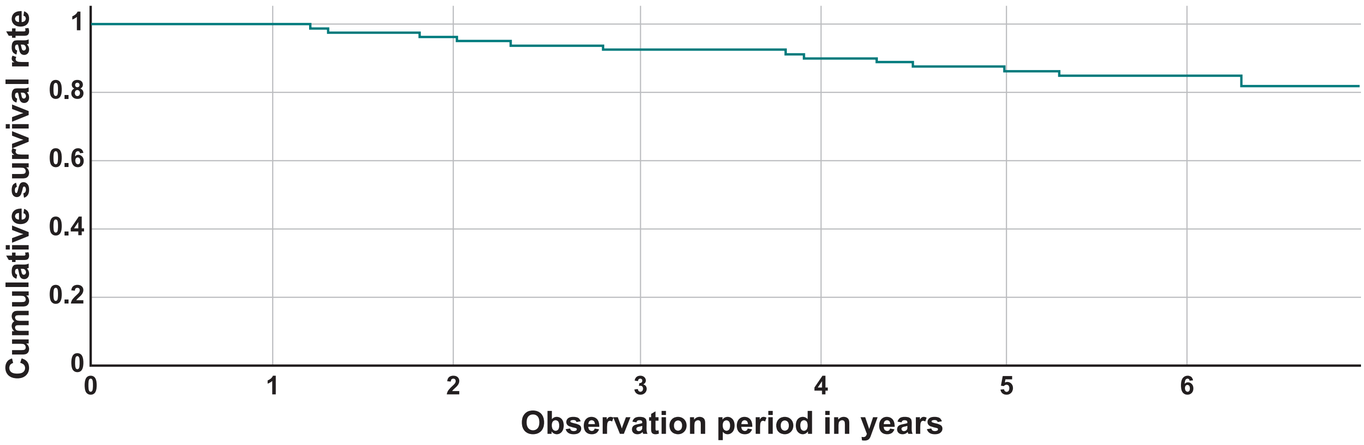

Figure 2. Restoration-based Kaplan–Meier survival function for the complication of implant-supported SCs

Table 1. Influence of patient and prosthesis variables on the incidence of failure and complication in 80 implant-supported SCs.

Variable	Category	SCs (N)	Failures of Implant-Supported SCs		Complications of Implant-Supported SCs	
			Number of Events	*P*	Number of Events	*P*
Gender	Male	39	4		10	
	Female	41	2	.29	4	.054
Medical history	No	79	6		13	
	Yes	1	0	.799	1	.07
Smoking & betel nut user	N0	80	6		14	
	Yes	0	0	1	0	1
Parafunctional habits	No	71	3		8	
	Yes	9	3	.035*	6	.008*
Jaw	Maxilla	38	3		7	
	Mandible	42	3	.949	7	.968
Tooth position	Premolar	26	1		3	
	Molar	54	5	.371	11	.258
Type of implant	Biomet 3i	21	1		4	
	Straumann tissue level	22	2		4	
	Straumann bone level	5	0		0	
	XiVE	32	3	.882	6	.752

*Significant p-values

Table 2. Overview of failures in the 80 implant-supported SCs during the 6-year examination

Restoration number	Gender	Tooth position	Function time(year)	Reason for failure
9	F	36	6.3	Implant failed
61	M	27	1.5	Implant failed
1	F	37	2.2	Crown fractured
42	M	34	1.5	Crown fractured
52	M	17	0.2	Crown fractured
65	M	17	5.1	Crown fractured

Table 3. Overview of complication in the 80 implant-supported SCs during the 6-year examination

Type of Complications	Number of Event	Complication Rate (%)
Ceramic chipping	1	1.25%
Abutment screw loosening	12	15%
Fracture of an abutment screw	1	1.25%
Fracture of an abutment	0	0%

Discussion

The overall six-year survival rate of the reconstructions in this prospective study was 92.5%, and the complication rate was 17.5%. This survival rate is similar to those from the two aforementioned systematic reviews.[8,10] However, both reviews reported lower complication rates compared to our result, particularly in the case of screw loosening. Schubert et al. recently reported a survival rate of 97.5% with no technical complications during an observation time of 5.9 ± 1.4 years, demonstrating a better outcome compared to our result.[11] This disparity may be attributable to the use of customized titanium abutments in our study. Schubert et al. employed titanium-base CAD-CAM abutments,[11] which reportedly show a better internal fit at the implant–abutment connection compared to custom abutments fabricated through a fully digitalized CAD-CAM process.[12] Misfit between implant and abutment can result in the loosening of screws, reduced preload, and in some cases, significant stress around the implant.[13] Hsu et al. also reported a higher rate of ASL with the same type of abutment.[14] Hsu et al. and other studies noted an increased misfit when compatible CAD-CAM abutments are associated with implants from other manufacturers, suggesting the importance of selecting manufacturers that consistently offer high quality to establish a more stable connection.[15]

Implant position plays a significant role in the prognosis of implant-supported prostheses. A recent systematic review by Rabel et al. reported a higher incidence of chipping in posterior all-ceramic implant-supported SCs.[10] In contrast, another systemic review by Pjetursson et al. found that posterior SCs with monolithic-reinforced glass–ceramics had a significantly lower rate of failure due to ceramic fracture compared to anterior SCs. The variability may also arise from different approaches to statistical analysis.[8] Further investigation is required to determine the difference between anterior and posterior implant-supported SCs fabricated with monolithic LDS.

Parafunctional habits were the only variable significantly correlated with both the survival rate and the complication rate in our study, consistent with previous studies.[2,16,17] In Kinsel et al.'s study, patients with a bruxism habit had approximately seven times higher odds of porcelain fracture and five times higher odds of major fracture compared to those without a bruxism habit.[16] Consequently, the fabrication of an occlusal appliance is recommended for patients with bruxism.

The comparison between monolithic LDS and other materials provides insights into selecting materials for implant-supported SCs. Hsu et al. evaluated posterior implant-supported SCs fabricated with metal–ceramic with a minimum six-year follow-up period and reported a higher success rate (100%) and a complication rate (16%) similar to those in this study.[14] The systematic review by Alqutaibi et al. reported similar outcomes related to prosthesis failure, mechanical and biological complication rates, and patient satisfaction for ceramic and metal–ceramic crowns. They concluded that the choice of material for a single implant crown depends on the dentist's and patient's preferences.[4]

Monolithic zirconia has gradually become the preferred material for implant reconstructions. New variations with tooth-like color and increased translucency offer aesthetic and stiffness benefits. De Angelis et al. reported similar clinical outcomes for monolithic LDS and monolithic zirconia over a three-year follow-up.[18] In a review by Pjetursson et al., monolithic LDS had a higher rate of core fracture. In contrast, monolithic zirconia showed a higher rate of abutment fracture and loss of retention, possibly due to different mechanical properties such as higher stiffness, transferring occluding force to less strong components of the implant–crown assembly.[8] Another study also suggested that the high flexural strength of monolithic zirconia used as a hybrid abutment crown may lead to deflection and deformation at the implant–abutment interface.[19] However, due to limited data, drawing any conclusions on the long-term clinical success of monolithic zirconia remains challenging.[8] Further research is necessary to evaluate its extended clinical performance.

A limitation of this study is the absence of data on biological complications, another crucial factor influencing the success of implant reconstruction. In addition, the same doctor fabricated the reconstruction and performed follow-up observations, which may limit the validity of the study, potentially leading to bias or limitations to the results. Confounding variables included the lack of uniformity in dental implant brands and the diameter and length of implants used as control factors, as well as the status of antagonist teeth. Despite these limitations, the information presented in this study suggests that monolithic LDS holds promise as a material for posterior implant-supported SCs.

Conclusions

Within the limitations of this clinical study, the following conclusions can be drawn. Six years of clinical observations in this study demonstrated that monolithic LDS is a promising material for posterior implant-supported SCs. This study found a relatively high complication rate, primarily attributed to ASL. Opting for a reputable manufacturer offering a precise implant–abutment connection may contribute to improved outcomes. In this study, the only variable significantly correlated with the clinical outcome was parafunctional habits. This issue can be addressed by fabricating an occlusal appliance for implant protection.

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Technical Report

Visualizing and fabricating a reduction guide for circumferentially parallel guiding planes with computer-aided design and computer-aided manufacturing technology

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Abstract

The preparation of appropriate parallel surfaces in accordance with tooth morphology influences the clinical performance of a partial removable dental prosthesis (RDP). Well-designed guiding planes that are prepared accurately around the abutment tooth ensure the stability of an RDP. We have created a novel reduction guide to design and fabricate continuous circumferential and parallel surfaces around abutment teeth by using computer-aided design and computer-aided manufacture (CAD/CAM). In conclusion, with help of CAD/CAM technology, design and production of a guiding plane reduction guide could be more precise and predictable.

Key words: guide plane, RDP, CAD/CAM, reduction guide

Introduction

A stable removal dental prosthesis (RDP) resists displacement due to functional, horizontal, and rotational stress.[1] Stability is a critical factor in patient satisfaction.[2] The stability of a partial RDP depends on well-designed guiding planes on the abutment teeth with two or more vertically parallel surfaces.[1,3,4] The intentionally prepared surfaces are usually placed on buccolingual curves according to the contour of the abutment teeth and 1.5–5.0 mm in occlusogingival height.[5-7] However, preparing continuous circumferential and parallel planes on abutment teeth is always challenging because of the morphology of the teeth. Conventionally, guiding planes are prepared freehand and verified on models,[6,7] assisted by reduction guides[8-14] or intraoral surveyors.[15,16] Computer-aided design and manufacturing (CAD/CAM) technology has also been used to design and manufacture reduction guides to prepare guiding planes for partial RDPs.[17-20] While digital technology allows more accurate and repeatable processes to design and prepare straight planes for an RDP, providing continuous circumferential and parallel planes around abutment teeth remains difficult. These clinical problems are overcome in this article by evaluating the path of insertion and survey line, analyzing areas of guiding planes, and fabricating a device for circumferential guiding plane preparation using CAD/CAM technology.

Methods

1. Survey the study model to determine the path of insertion of the RDP with the attached pin index using a laboratory surveyor (Dental Surveyor, Tungsheng Co., Tapipei, Taiwan; Fig.1).
2. Scan the study model to create a standard tessellation language (STL) file with a laboratory scanner (E3, 3 shape, Copenhagen, Denmark) and import it into CAD software (Autodesk Meshmixer, Autodesk, San Francisco, USA) . Create and combine a cylindrical object aligned with the pin index on the study model for ease of orientation; it is challenging to assign the same direction to the face normal from the top of the pin after scanning since the pin's surface is irregular at microscopic scale of the mesh (Fig. 2). Align the orientation of the study model by cylindrical object with the positive z-axis of the world coordinate to facilitate later dimensional adjustment of the object in the x- and y-axes.
3. Build a columnar 3D object as a reduction guide for the RDP abutment tooth. Two methods are presented for this process. The first method labels the abutment tooth (Fig. 3A) and selects the visible area from the top view using the selection modify function to define the area above the survey line (Fig. 3B). Care must be taken to ensure that no face normal without positive orientation in z-axis is selected. Otherwise, an overlapped or inverted normal would be encountered during the extrusion process, leading to processing errors. Use the selection modify function to optimize and smooth the border of the selected surface and extrude it as a 3D columnar object, and adjust the column dimension in the x- and y-axes for a suitable range of the guiding plane circumferentially exposed between the column and the model (Fig. 3C and 3D). The second method uses several small 3D round or elliptical cylindrical objects to approximate the range of the reduction guide of the 3D columnar object like in the first method (Fig. 4A and 4B). Combine all the small round or elliptical cylindrical objects with the Boolean union to simplify the process in the next step.

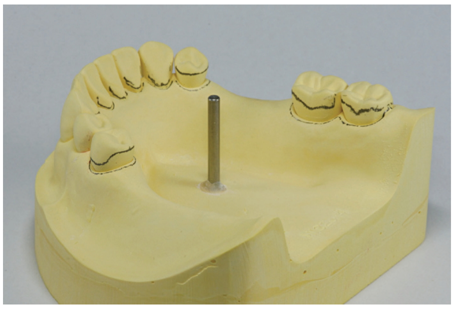

Figure 1.
Attach a pin to the study model to indicate the path of insertion.

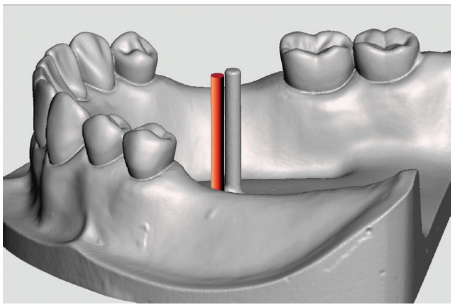

Figure 2.
Place a cylinder next to the pin on the standard tessellation language (STL) model for easy alignment.

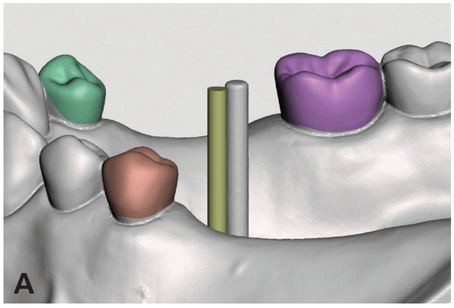

Figure 3A.
Select abutments.

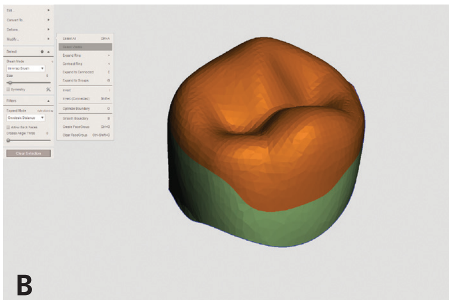

Figure 3B.
Select the visible portion from the top view above the survey line.

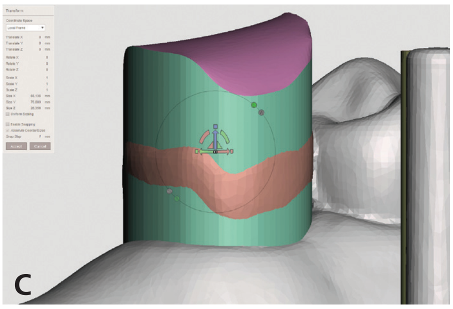

Figure 3C.
Flatten the selected area and extrude a column for guiding plane range adjustment in the x- and y-axes.

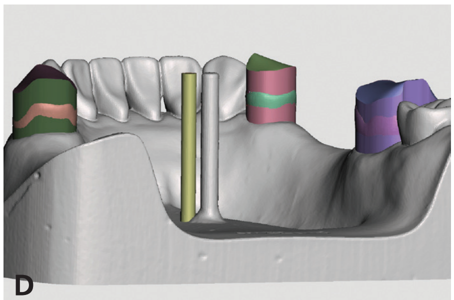

Figure 3D.
Prepare all columns.

4. Process the reduction guides from the designed 3D columnar objects and the study model using the Boolean difference (Fig. 5). Please make sure to remesh the columnar object and adjust the mesh density to closely match that of the study model in the wireframe view. This step helps to reduce any edge discrepancies caused during the Boolean operation. In addition, unchecking "Auto-Reduce Result" in the Boolean function box could avoid morphological changes around the object border during Boolean processing in Meshmixer. Select and remove the remaining portion below the guiding plane.
5. The parts of the guides on the abutment teeth are connected with an object extruded from the study model to increase the accuracy of the reduction guide positioning on the teeth. Additionally, some windows are incorporated on the occlusal surface of the reduction guide to confirm full seating on the teeth (Fig. 6A).
6. Prepare the output STL reduction guide model in the processing software (Phrozen 3D, Phrozen Tech Co., Hsinchu, Taiwan) to orient the tissue surface of the model away from the build plate, add and arrange printing supports (Fig. 6B), slice into printing layers, and output in the 3D printer format. Fabricate the reduction guide with printable resin (DD guide, Enlighten Materials, Taipei, Taiwan) using a 3D printer (Sonic, Phrozen Tech Co., Hsinchu, Taiwan; Fig.7).
7. After removing all printing support and checking the fit on the study model, the reference plane on the reduction guide is painted black (Fig. 8) for easier discrimination and as a contact indicator during guiding plane preparation.

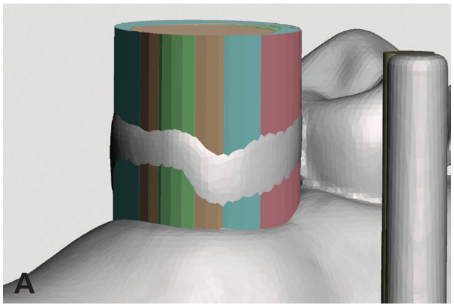

Figure 4A.
Another method to make columns uses round and elliptic cylinders.

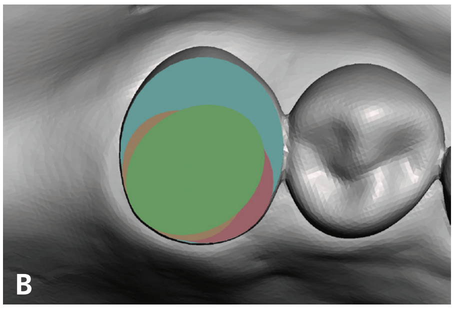

Figure 4B.
The top view shows a column formed by four cylinders.

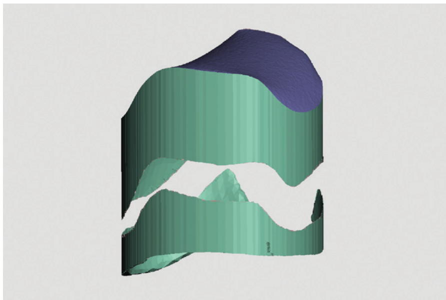

Figure 5.
A reduction guide is formed by the Boolean difference between the column and the study model. The lower portion is removed later.

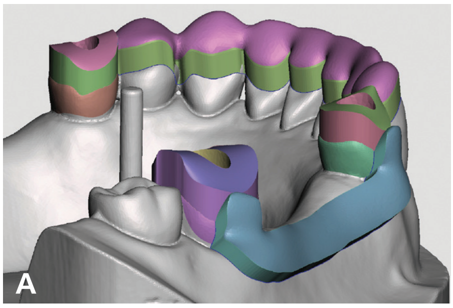

Figure 6A.
Connect designed reduction guides.

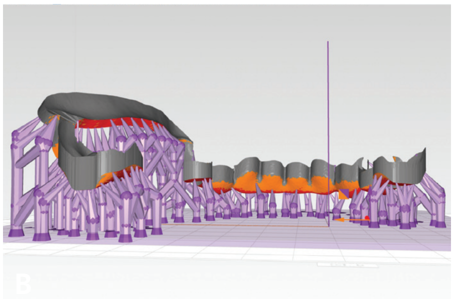

Figure 6B.
Orient reduction guide and apply printing support in Phrozen 3D.

Figure 7.
The finished reduction guide on Typodont.

Figure 8.
The reference plane of the reduction guide is painted black for better visualization.

Discussion

The fabrication of guiding planes improves the stability of an RDP and its resistance to displacement due to horizontal or rotational stress.[3,4] The number of parallel surfaces in a partially edentulous ridge should be maximized to increase the quality of stabilization[4] especially in situations when few abutment teeth remain. Additionally, establishing parallelism between distant teeth without the help of a device is challenging.[18]

Conventionally, an acrylic resin block molded on the occlusal surface of the model's abutment teeth and processed with a three-axis milling machine mounted on a survey machine is used for reference to reduce the guide plane.[4,11] The milling process is performed on both the resin block and the stone model. This process cannot be reversed if the surfaces are over-prepared.

With the aid of digital technology, the morphology of the abutment teeth could be evaluated from the x-, y-, and z-axes separately, and the region of the guide plane could be determined more explicitly. Currently, many dental digital design software are on the market that can perform similar functional operations. However, if we do not want to invest too much in professional software, Meshmixer is freeware worth considering, although its development was discontinued in 2021.

The Boolean operation is one key operation in every 3D modeling software. In dental design software, the Boolean operations are integrated and concealed into the design process. The Boolean operations encompass merging, subtracting, or intersecting digital objects, necessitating the mesh of manipulated objects to be manifold, devoid of inverted face normals, and exhibit closely matched mesh face density. Consequently, our approach involves a meticulous selection of the guide area and the remeshing of objects during the procedural steps. Being an experimental basic 3D modeling software, Meshmixer has limited debugging and error-proofing capabilities. Therefore, when the objects undergoing Boolean operation cannot be adequately prepared, alternative robust software becomes a viable option for simplifying the workflow. Moreover, all the steps in our demonstration could be substituted with any other software featuring similar functions, provided that the same orientation is maintained and potential quality changes in the digital model during transitions between software applications are addressed.

Based on its relatively low cost, versatile forming capabilities in multiple directions, and ability to capture fine details, we used a masked stereolithography 3D printer to fabricate the guide. The resin printing material is brittle and flexible, necessitating careful consideration of structure thickness and strength during model construction. Moreover, the 3D printing process is technically sensitive, with the dimensional and morphological accuracy of the product being influenced by various factors such as printing support arrangement, setting of printing parameters, and post-processing procedures such as washing, curing, and support removal. Consequently, using a dental model as a fitting standard before intraoral use is advantageous. When higher mechanical strength is imperative, making a guide by milling resin blocks becomes favorable.

This method is more likely to create continuous circumferential and parallel surfaces around the abutment teeth, avoid over-preparation of tooth structure, and approach the goal of a single path of insertion for the RDP. However, since the guide rests on the teeth, the accuracy of the guide plane's preparation depends on factors such as the number, mobility, and distribution of the teeth involved. When dealing with a limited number of teeth, it is advisable to incorporate a structure with greater soft tissue coverage into the preparation guide's design. Additionally, we used inspection windows and transparent materials for this case to ensure proper attachment of the preparation guide to the abutment tooth. It is recommended that all essential components on each abutment tooth be connected into a single cross-arch unit to enhance the manageability of the guide. We can more effectively attain our objectives of well-prepared guide planes through meticulous design and material handling.

Conclusion

Using CAD/CAM technology, a reduction guide for continuous circumferential and parallel guiding planes according to the morphology of the abutment teeth can be fabricated precisely and predictably for an RDP.

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Case Report

Full mouth rehabilitation of edentulous patient with implant assisted dentures - A case report

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Abstract

Implant overdentures emerge as a superior option for individuals lacking teeth, providing improved chewing function and enhanced quality of life compared to traditional complete dentures. The removable design also simplifies oral hygiene maintenance in contrast to fixed implant prostheses. A thorough evaluation of the patient's condition is imperative before commencing implant overdenture treatment. Meticulous planning, taking into account factors such as attachment type, number of implants, and precise implant locations, is essential for achieving successful outcomes. This case report outlines a prosthetic reconstruction process that combines a maxillary implant overdenture with a mandibular implant-assisted removable partial denture for a 62-year-old woman. The patient expressed satisfaction with the esthetics, function, and comfort of the dentures.

Key words: Dental implants, implant overdentures, implant-assisted removable partial denture, interocclusal space, Locator attachment

Introduction

Edentulous patients often face functional and psychosocial challenges due to ridge atrophy and difficulties adapting to removable dentures, leading to discomfort during chewing, inadequate stability, and poor denture retention. Implant overdentures provide an effective solution by offering improved masticatory function and overall improved quality of life compared to conventional complete dentures. However, prosthetic complications, such as denture base fractures, attachment loosening, and attachment wear, are inevitable in implant overdentures.[1] Their impact can be minimized through high-quality prostheses and vigilant follow-up protocols. Therefore, it is essential for clinicians to possess a thorough understanding of implant overdentures, including implant planning, prosthetic design considerations, occlusal concepts, and maintenance protocols.

For successful outcomes, thorough data collection and analysis, including assessment of interocclusal space, jaw relationship, and bone quantity, are crucial in planning implant overdenture treatment. Dentists must meticulously design the implant overdenture based on this analysis, considering attachment type, number of implants, and their distribution. Varying interocclusal space requirements call for different attachment systems.[2] Furthermore, different attachment systems and arches require different implant numbers and distributions to ensure optimal stress distribution and survival rates.[3–6] When considering prosthetic design, incorporation of metal reinforcement into the denture base is crucial to mitigate issues such as denture fracture and deformation. In addition, the technique for pick-up attachment and the choice of materials play significant roles in minimizing complications, such as attachment loosening and wear.[7]

This clinical report outlines a prosthetic rehabilitation involving a maxillary implant overdenture and a mandibular implant-assisted removable partial denture, both using stud-type attachments. The report emphasizes factors associated with potential complications in implant overdentures.

Case report

A 62-year-old woman sought evaluation at the Department of Prosthodontics at National Cheng-Kung Hospital due to difficulties in chewing, dissatisfaction with the aesthetics of her old denture, and mobility issues with her lower teeth (Figs. 1–3). Clinical examination revealed full edentulism in the maxilla and partial edentulism classified as Kennedy Class I in the mandible. The residual ridge of the maxilla was classified as Atwood Class III (posterior ridge, high and well-rounded) and Class V (anterior ridge, low and well-rounded), with no torus palatinus observed (Fig. 4A). In the mandible, the posterior teeth were missing and the patient had not worn a lower removable denture before. A periodontal examination revealed generalized horizontal bone loss affecting anterior teeth, characterized by deep probing depths and grade III mobility noted in teeth 43 and 42 (Fig. 5). Extraction of teeth 43 and 42 was recommended. The residual ridge of the mandible was classified as Atwood Class V, with no bony exostosis observed (Fig. 4B).

To confirm the diagnosis and devise an appropriate treatment plan, dental casts of both jaws were mounted on a semi-adjustable articulator (Artex CT, Amann Girrbach, Austria) in centric relation. The correct vertical dimension was established using wax rims. A comprehensive space analysis was performed to help determine the treatment plan. The interocclusal space was between 9 and 12 mm in both jaws (Fig. 6). The primary treatment objectives included restoration of vertical height, enhancement of masticatory function, and improvement of aesthetics. Following analysis of the study cast, three treatment plans were proposed: implant-fixed dental prostheses with extraction of lower teeth; maxillary implant overdenture with mandibular implant-assisted removable partial denture; and maxillary conventional complete denture with a mandibular conventional removable partial denture. The patient expressed a preference for the first treatment plan, which involved implant-fixed dental prostheses.

Before definitive treatment, interim dentures were fabricated to assess functional and occlusal stability (Fig. 7). After the patient had worn these interim dentures for three months, a cone-beam computed tomography scan was performed using maxillary and mandibular radiographic templates fabricated based on scan data from the interim dentures. Zirconia balls were embedded in the templates at every missing tooth position to indicate the planned implant positions in the measurement radiograph (Fig. 8). However, the radiographic examination revealed insufficient bone quantity for implant-fixed dental prostheses, leading to modification of the treatment plan to a maxillary implant overdenture with a mandibular implant-assisted removable partial denture, both employing stud-type attachments. Implant positions were planned at teeth 14, 16, 24, and 26 in the maxilla and teeth 43, 46, and 36 in the mandible (Fig. 9). A surgical guide was meticulously fabricated for the implant surgical plan (Fig. 10). The diameters and lengths of the implants (OsseoSpeed TX, Astra Tech, Dentsply Sirona, USA) were as follows: implants 14, 24, and 43 were 3.5 × 9 mm; implants 16 and 26 were 4.0 × 9 mm; implant 36 was 5.0 × 9 mm; and implant 46 was 4.0 × 6 mm. Ti mesh (Titanium Micro Mesh, ACE, USA) and FDBA bone graft (OraGraft, Lifenet Health, USA) were applied at implant 14 and 24 for bone augmentation (Fig. 11). After two weeks, sutures were removed and the patient was advised to return for follow-up.

During the follow-up phase, interim dentures were relined using a soft denture reline material (SOFT-LINER, GC, Japan) to preserve the patient's chewing function. After six months of implant placement, second-stage surgery was performed. Implants 14, 16, 24, 26, 36, 43, and 46 were surgically exposed, and healing collars were placed.

For the definitive prosthetic treatment, individual trays were fabricated by taking close-tray impressions for both jaws. The working cast underwent relief and blockage with paraffin wax (SIVUCH, LIANG LINN, Taiwan) for subsequent open-tray impressions, with the trays constructed using base plate material (Vertex Baseplate, Vertex Dental, Netherlands). The mandibular teeth were prepared for the guiding plane and cingulum

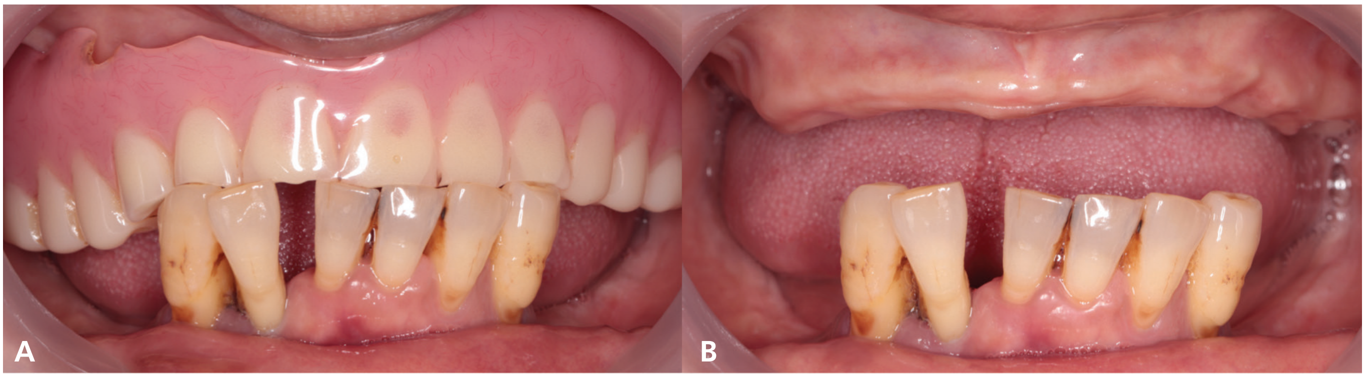

Figure 1. Pre-treatment intra-oral view. (A) With old denture; (B) without old denture.

Figure 2. Pre-treatment extra-oral view. (A) Frontal view; (B) lateral view.

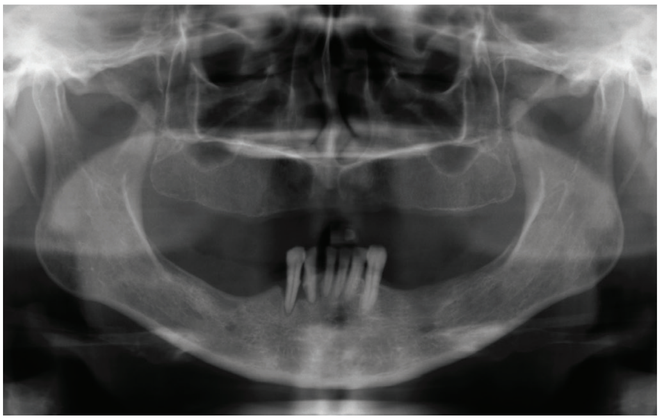

Figure 3. Pre-treatment panoramic film.

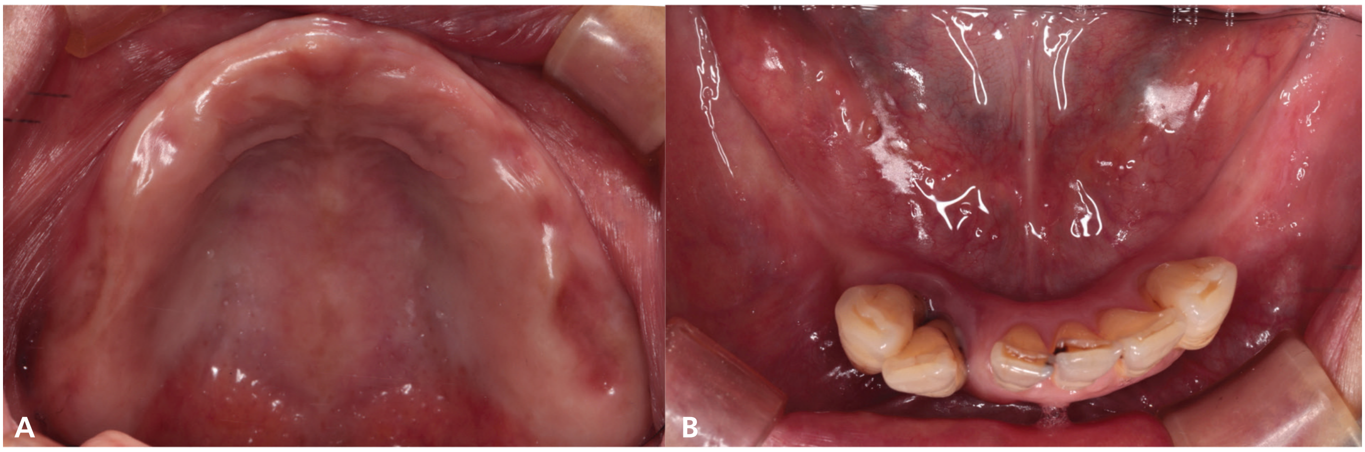

Figure 4. Pre-treatment intra-oral view. (A) Occlusal view of the maxillary arch; (B) occlusal view of the mandibular arch.

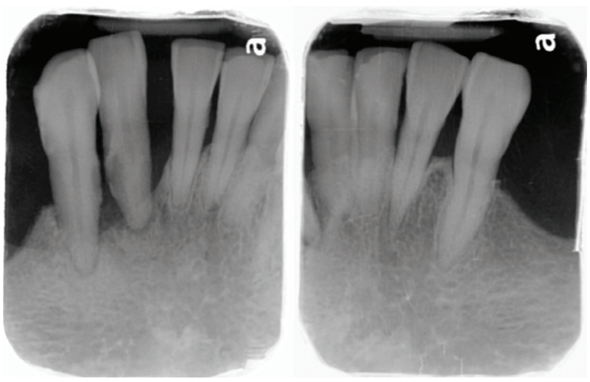

Figure 5. Pre-treatment periapical films.

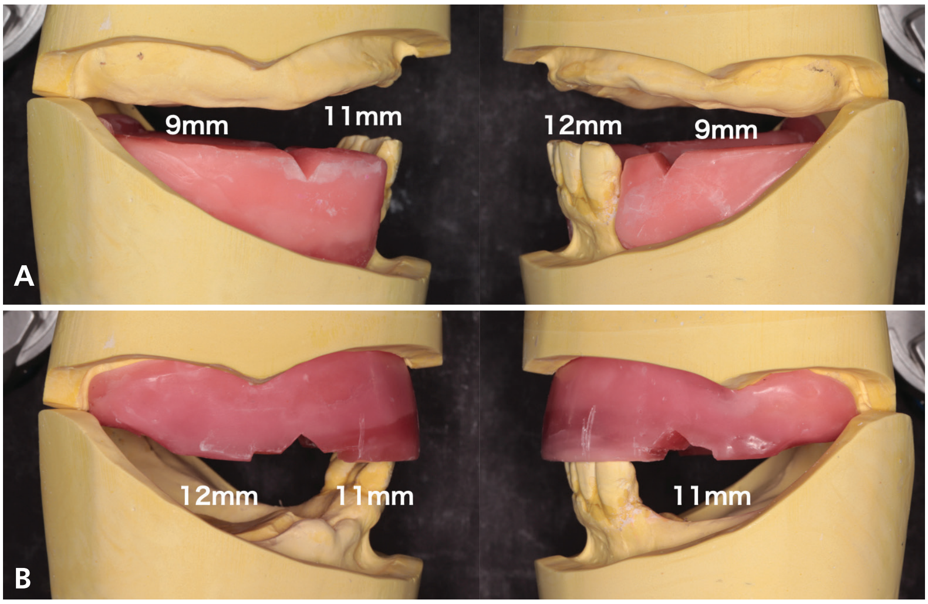

Figure 6. Space analysis of the semi-adjustable articulator. (A) Maxilla; (B) mandible

Figure 7. The interim dentures. (A) Occlusal view of the maxillary arch; (B) occlusal view of the mandibular arch; (C) right side; (D) facial aspect; (E) left side.

Figure 8. Radiographic stent with zirconium pearls. (A) Maxilla; (B) mandible.

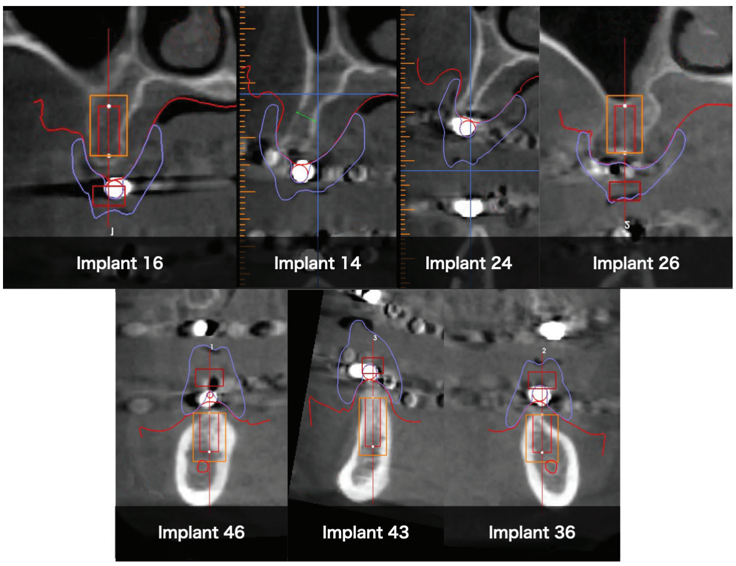

Figure 9. Cone-beam computed tomography images of implants 14, 16, 24, 26, 36, 43, and 46.

Figure 10. Implant surgical stent. (A) Maxilla; (B) mandible.

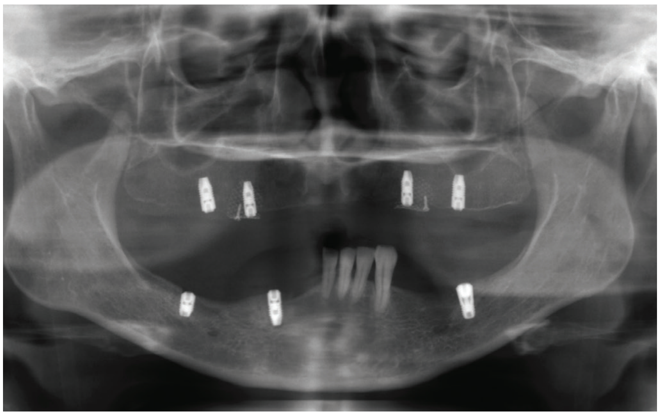

Figure 11. The panoramic film after implant placement.

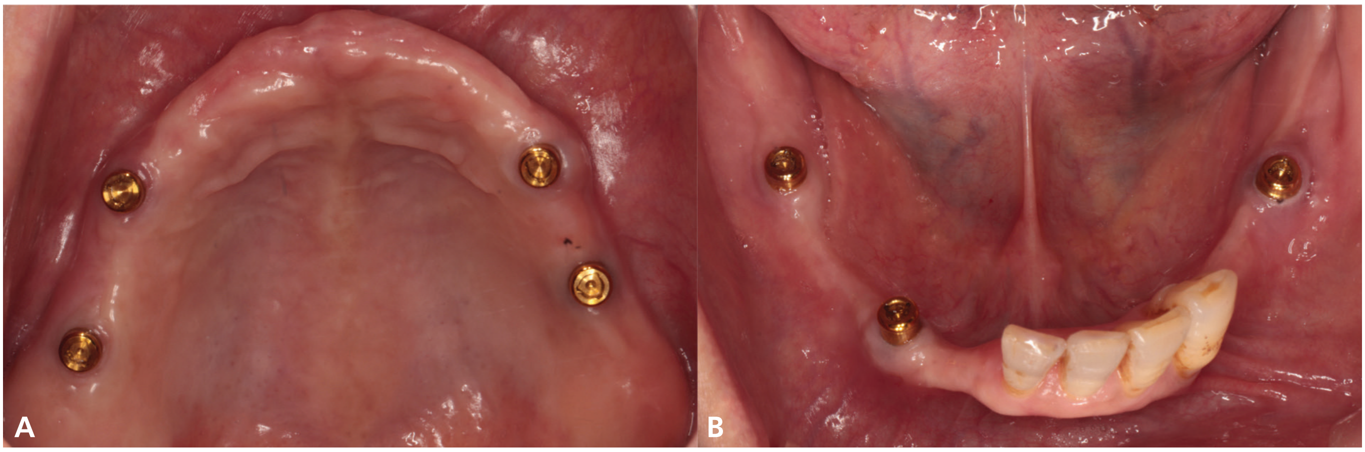

Figure 12. Locator abutment delivery. (A) Occlusal view of the maxillary arch; (B) occlusal view of the mandibular arch.

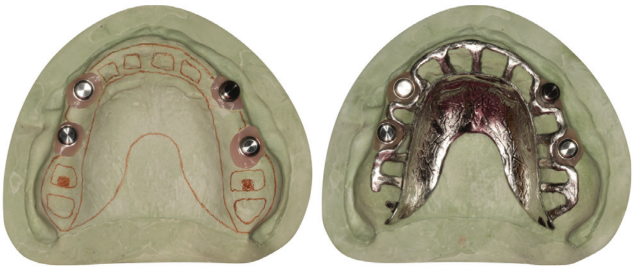

Figure 13. . The metal framework of maxillary implant overdenture. (A) Design; (B) metal framework.

Figure 14. The metal framework of mandibular implant-assisted removable partial denture. (A) Design; (B) metal framework.

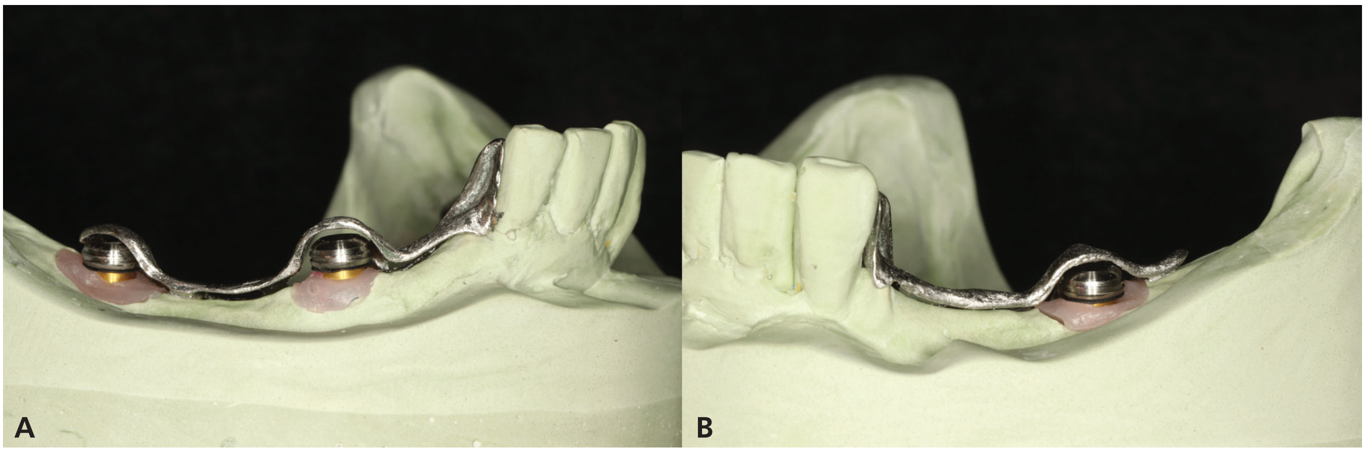

Figure 15. Checking the space between the framework and metal housing. (A) Right side; (B) left side.

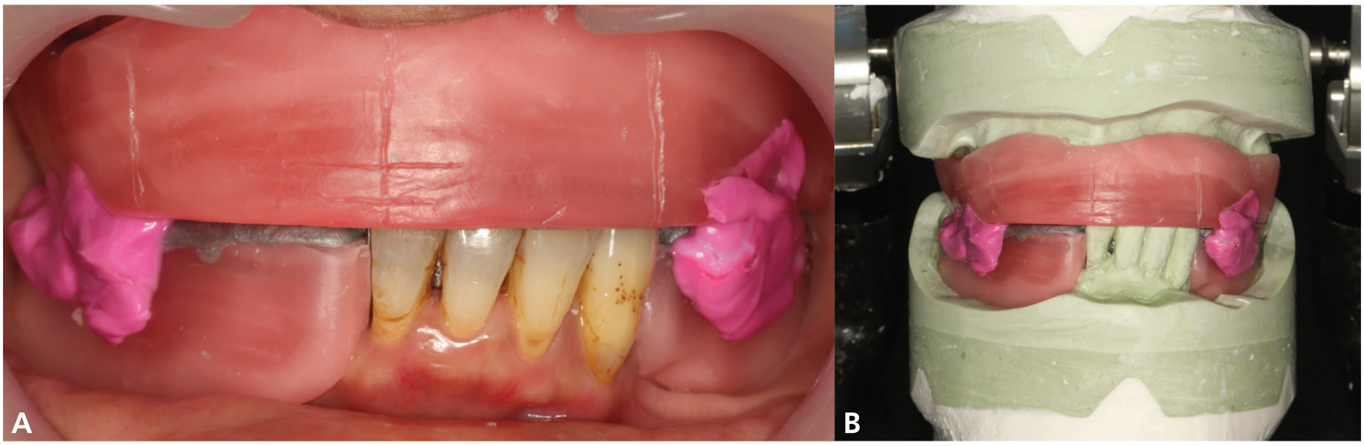

Figure 16. (A) Vertical dimension determination and bite record registration; (B) master cast mounted on a semi-adjustable articulator.

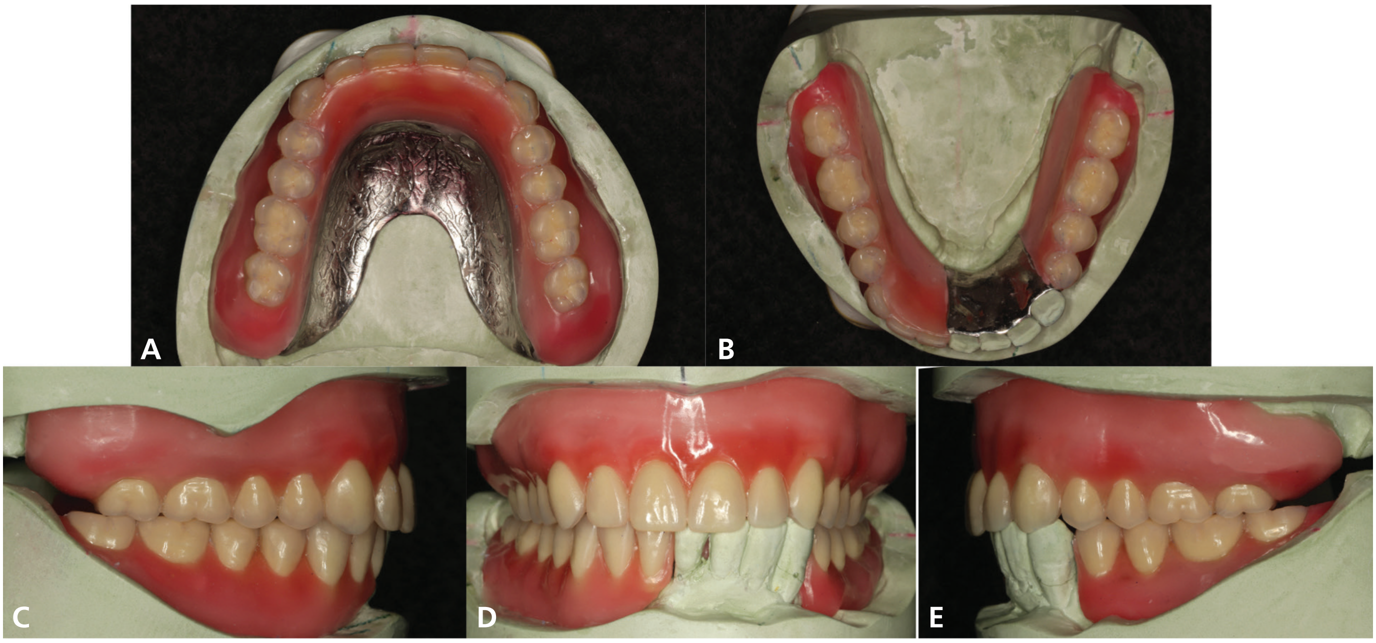

Figure 17. Teeth arrangement. (A) Occlusal view of the maxillary arch; (B) occlusal view of the mandibular arch; (C) right side; (D) facial aspect; (E) left side

Figure 18. Delivery of maxillary and mandibular dentures. (A) Occlusal view of the maxillary arch; (B) occlusal view of the mandibular arch; (C) right side; (D) facial aspect; (E) left side.

Figure 19. Postoperative extra-oral view. (A) Frontal view; (B) lateral view.

rest, guided by a preparation guide. In both jaws, open-tray impression copings were attached to the implants. Border molding was performed, and a final open-tray impression was taken.

The Locator attachment (LOCATOR, ZEST DENTAL SOLUTIONS, USA) was chosen based on gingival thickness and implant angulation (Fig. 12). The master casts obtained were examined and the cast framework was designed using a surveyor. The maxillary framework was designed with a U-shaped major connector because the patient did not want palatal coverage. In addition, a Ladder-type minor connector was incorporated without covering the metal housing of the attachment due to limited interocclusal space for tooth arrangement (Fig. 13). In the mandibular framework design, elements included a lingual plate, a Ladder-type minor connector covering the metal housing of the attachment for less strain on the denture, a cingulum rest on tooth 33, and proximal plates on teeth 41 and 33 (Figs. 14 and 15). Subsequent laboratory procedures were carried out based on the designed metal framework. The completed framework underwent clinical examination to confirm both acceptability and a passive fit.

The appropriate occlusal vertical dimension was established using a wax rim and confirmed through techniques such as phonetics, aesthetics, swallowing, physiological rest position, and assessment of interim dentures. The orientation of the upper occlusal plane was determined using the ala–tragus line and the interpupillary line as reference landmarks. Subsequently, master casts of both jaws were mounted on a semi-adjustable articulator with a facebow transfer (Fig. 16). Acrylic teeth (SR Vivodent S PE & SR Orthotyp, Ivoclar, Liechtenstein) were arranged on the wax rim in the maxillary and mandibular edentulous areas (Fig. 17). Full wax dentures were clinically tested to reassess the occlusal vertical dimension, occlusion, phonetics, and overall appearance.

The denture was processed, and laboratory remounting was performed to fine-tune the occlusion. The prosthesis was then delivered to the patient, accompanied by denture care instructions. After the patient wore the dentures for a week, a clinical remounting procedure was performed to enhance occlusal stability (Figs. 18 and 19). After the dentures were used for a month, the metal housing of the Locator attachment was picked up with denture reline material (Denture Liner, SHOFU, Japan). A minimum retention force of 2–3 kilograms per arch is essential. Therefore, for the maxillary implant overdenture, four blue nylon inserts, each providing 680 grams of retention, were employed, resulting in a total retention force of approximately 2.7 kilograms. In the case of the mandibular implant-assisted removable partial denture, a pink nylon insert, providing 1360 grams of retention, was applied to implant 36, while two blue nylon inserts were used for implants 43 and 46 (Fig. 20). The total retention force of the mandibular implant-assisted removable partial denture also amounted to approximately 2.7 kilograms. The patient reported satisfactory masticatory function with this level of retention force, and the dentures were easy to remove for maintenance purposes.

During follow-up visits, the patient expressed satisfaction with the aesthetics, function, and comfort of the dentures. Frontal and profile views demonstrated an enhanced appearance after the insertion of the new dentures. Postoperative periapical films indicated the stable periodontal and periapical status of the remaining teeth. At the 3-year follow-up visit, mild wear on the attachments in both jaws and slight retention loss were observed. To improve occlusal stability and denture retention, occlusal adjustments and changes to the nylon inserts were made.

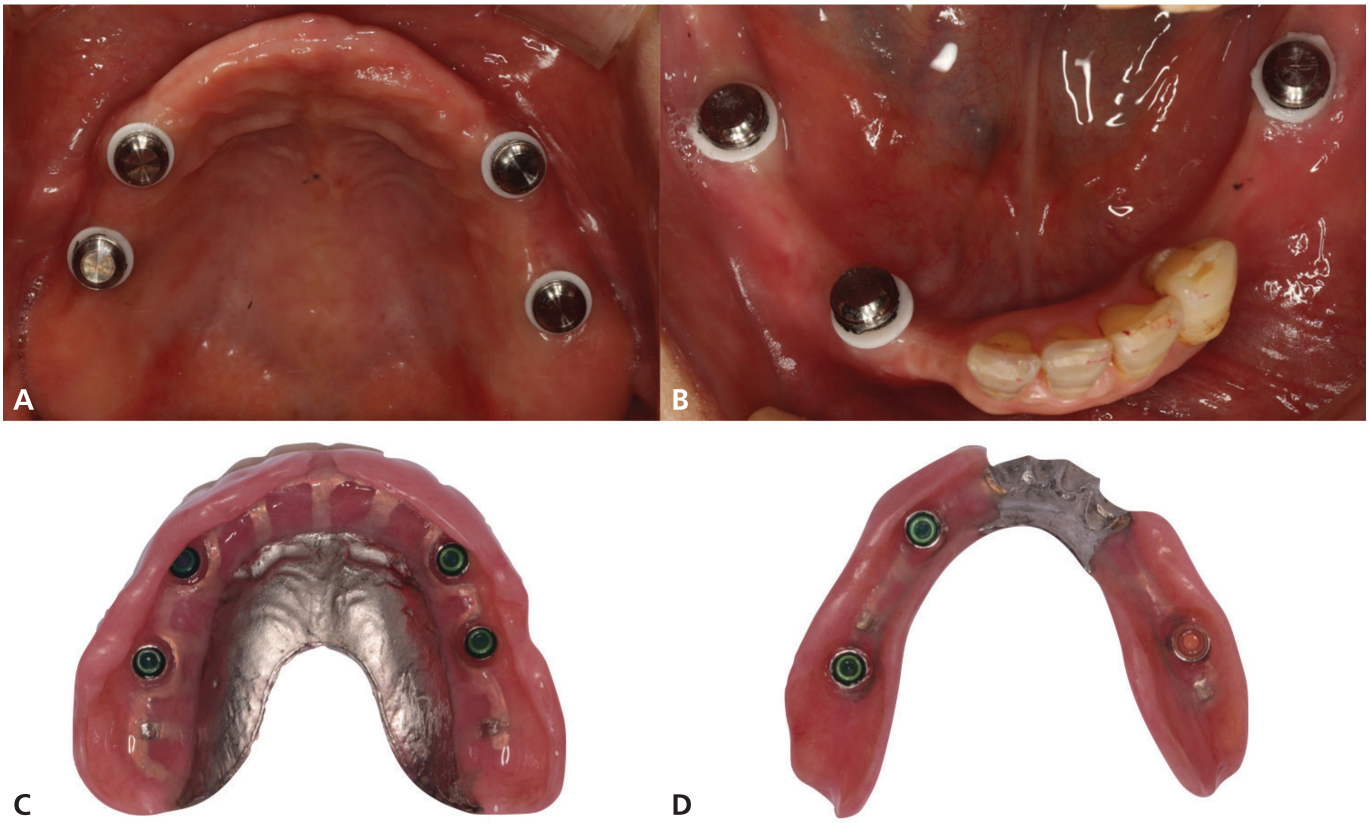

Figure 20. Locator attachment pick-up with chair-side technique. (A) Process kit insertion in the maxilla; (B) process kit insertion in the mandible; (C) maxillary implant overdenture after nylon insertion; (D) mandibular implant-assisted removable partial denture after nylon insertion.

Discussion

Implant overdentures are an excellent option for edentulous patients because they provide greater masticatory function and improved quality of life compared to conventional complete dentures. In addition, their removability allows for easier access for oral hygiene compared to fixed implant prostheses. Before starting implant overdenture treatment, the dentist must thoroughly assess the patient's condition and plan implant placement carefully, considering attachment type, implant number, and precise locations for successful outcomes.

The interocclusal space is pivotal in determining the attachment type for implant overdentures. Ahuja et al.[2] proposed a classification with four classes for restoring edentulous arches with implant overdentures. Class I denotes an interocclusal space larger than 15 mm, for which either bar-type or stud-type attachments are suitable. Caution is needed due to the increased space, which poses a higher risk of cantilevered occlusal loading. For Class II (12–14 mm), bar-type or stud-type attachments are applicable, with attention to space distribution to prevent denture fracture. For Class III (9–11 mm), stud-type attachments are suitable, with emphasis on assessment of attachment height and width. A metal framework may reinforce the overdenture. For Class IV (<9 mm), implant overdentures are unsuitable; interventions such as alveoloplasty, increase in vertical dimension, or alteration of the occlusal plane may be necessary to create the required space. In this case, the interocclusal space in both jaws measured 9–12 mm and was classified as Class III. Therefore, Locator attachments were selected to retain the implant dentures.

For mandibular implant overdentures, both the McGill consensus[3] and the York consensus[4] recommend a mandibular overdenture supporting two implants as the preferred minimum treatment for edentulous patients. In the case of maxillary implant overdentures, studies, including a systematic review by Raghoebar et al.,[5] highlighted that a maxillary overdenture supported by more than four splinted implants showed high implant and overdenture survival rates. Conversely, the use of fewer than four implants with non-splinted attachments increases the risk of implant loss. Di Francesco et al.[6] supported the use of an overdenture with a minimum of four implants for higher implant survival rates. Notably, the overdenture survival rate remained high irrespective of the number of implants. They suggested further studies to determine the advantages of splinting versus non-splinting.

The implant location is crucial for stress distribution and denture stability. In mandibular implant overdentures, the positioning of the implants over the canine or lateral incisor is crucial. The posterior part of the overdenture settles onto the soft tissue, providing superior support in stress-bearing areas like the buccal shelf. Placing implants too posteriorly may cause denture rocking around the fulcrum line. In addition, the anterior part, a non-stress bearing area, may contribute to bone resorption if not properly addressed.

For maxillary implant overdentures, implant location is influenced by factors such as residual bone, maxillary sinus extension, arch shape (V-shape or U-shape), and jaw relationship. Two regions, anterior and posterior, are considered for implant placement.[6] Dentists often prefer the anterior region due to a good stress-bearing area over the hard palate. In V-shaped arch forms, there is higher anterior cantilever force on implants. The jaw relationship influences occlusal force, with higher anterior cantilever force in Class III malocclusion. Hence, the anterior region is deemed more suitable. When four implants are chosen, they tend to be positioned between the canine and second premolar. Due to anatomical limitations, anterior implants are often not perpendicular to the occlusal plane, leading to increased stress concentration. Therefore, the placement of implants more anteriorly is generally not recommended.

This case report demonstrates the use of an implant-assisted removable partial denture to rehabilitate mandibular dentition in a Kennedy Class I edentulous scenario. Kennedy Class I, characterized by few remaining teeth for support and retention, often leads to increased instability of removable partial dentures (RPDs) and necessitates frequent adjustments, such as relining or fracture repair. The incorporation of additional implants in the posterior region of distal free-end RPDs has been suggested to improve function and stability. The requisite number of implants may vary depending on factors such as the length of the edentulous area, opposing dentition, and the presence of heavy bite forces, particularly common in patients with parafunctional habits. Increased implant numbers can help distribute stress more evenly around each implant and the surrounding bone, when enhanced prosthesis support is needed.[8] In the case of implant positioning, distally placed implants were observed to reduce stress at the edentulous area, transforming Kennedy Class I into a more favorable arch configuration resembling Kennedy Class III. Ortiz et al.[9] demonstrated that implant placement in the first molar area yields improved biomechanical outcomes, considering general displacements and maximum stress values, as well as their distribution in peri-implant bone, RPD metal framework, and implant. Moreover, when the clasps of existing RPD offer inadequate retention or their visibility is aesthetically unfavorable, implants can be positioned mesially adjacent to the abutment teeth. Placement of the implant next to the abutment tooth also aids in reducing occlusal forces on the abutment tooth.[8] Hence, in this case report, implants were placed in the areas of teeth 36, 43, and 46 to achieve broad stress distribution and improve aesthetics by eliminating the need for clasps.

Metal framework reinforcement of implant overdentures reduces denture strain, preventing fractures and minimizing residual ridge resorption. It also decreases strain on underlying implants by ensuring an even distribution of force across the implants. Studies by Takahashi et al.[10,11] have shown that framework design significantly influences strain on overdentures and implants. A full palatal coverage framework has a strain similar to that of a palateless framework with a palatal bar, while a palateless framework without a palatal bar tends to induce more strain. The highest strain on the denture is around the abutment, and denture fractures commonly occur in areas adjacent to the attachment. Thus, the design of the framework around the attachment is crucial, with metal reinforcement over the tops of the coping showing the least strain, followed by metal reinforcement over the sides of the coping.[12] In this case, the mandibular metal framework was designed to cover the metal housing to reduce strain on the denture. However, due to limited interocclusal space, the maxillary metal framework extended over the sides of the metal housing to facilitate easier tooth arrangement.

In stud-type implant overdentures, there are two techniques for pick-up attachment housing: laboratory pick-up and chair-side pick-up. The laboratory pick-up method incorporates metal housing during denture packing, while chair-side pick-up involves intra-oral incorporation with binding material. Laboratory pick-up offers reduced chair time, avoids mucosal contact with monomer, and provides a secure bond with the processing cap. However, disadvantages include potential binding errors and variations in settlement, leading to additional maintenance appointments. Chair-side pick-up addresses these issues but is technique-sensitive during intra-oral incorporation. Overall, the chair-side pick-up technique is considered a better choice. The incorporation of an attachment housing within the overdenture base significantly reduces the flexural strength of PMMA resin. Ozkir et al.[13] showed that PMMA-based acrylic resins, used as binding material for retaining the metal housing, exhibit superior flexural strength compared to composite resin-based retaining material and hard reline material. Domingo et al.[14] demonstrated that auto-polymerized acrylic resin has significantly higher flexural strength compared to light-polymerized acrylic resin. They also suggested that surface treatment of metal housing with silica-modified 30 μm aluminum oxide and silane produces higher flexural strength in denture blocks repaired with auto-polymerized acrylic resin. In addition, an issue frequently encountered in clinical practice with the locator attachment is the gradual detachment of its metal housing from the denture base resin over time. Nakhaei et al.[7] suggested using heat-polymerized acrylic resin for embedding the locator housing, which leads to a stronger bond between the metal housing and the denture base resin compared to auto-polymerized acrylic resin and auto-polymerized composite resin. The application of an alloy primer enhances the shear bond strength of the acrylic resin bond with titanium alloy.[15] However, Nakhaei et al.[7] found that the use of an alloy primer did not result in higher strength of the bond between the metal housing and denture base resin with auto-polymerized composite resin. Metal housings with undercuts on their axial wall provide mechanical retention for the retaining material. Consequently, the bond strength mainly relies on mechanical bonds, while the effect of chemical bonds is insignificant.

A systematic review by Assaf et al.[1] outlined a maintenance protocol for removable dentures, covering basic routines such as occlusion control and relining. Implant overdentures demand extra attention to assess attachment replacement needs. Success with overdentures means replacing the male part less than twice in the first year and up to five times in five years. Minimum retention of 2–3 kilograms per arch is required.[16] In a 4-implant maxillary overdenture with Locator attachment, a blue nylon insert is recommended, providing 680 grams of retention, extendable to 2.7 kilograms with four pieces. For a 2-implant mandibular overdenture, a pink nylon insert providing 1360 grams of retention, reaching 2.7 kilograms with two pieces, is suggested. However, starting with the smallest retention force is advisable, with adjustments made by the patient as needed.

Conclusion

An implant overdenture offers edentulous patients a stable removable option, resulting in increased patient satisfaction and improved quality of life. This case report outlines the fabrication of a maxillary implant overdenture supported by four implants and a mandibular implant-assisted removable partial denture supported by three implants. Both dentures used stud-type attachments due to limited interocclusal space, classified as Class III. Implant positioning was carefully planned based on bone volume and strategically distributed to enhance support and retention. In addition, the implant-assisted dentures were reinforced with metal frameworks to prevent denture fracture. Follow-up visits indicated stable periodontal status and only minor adjustments to ensure long-term comfort and functionality. Overall, the treatment provided significant benefits in terms of aesthetics, function, and patient well-being.

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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. **<u>Aims:</u>** briefly explain the importance of the study topic and state a precise study question or purpose. **<u>Materials and Methods:</u>** briefly introduce the methods used to perform the study; include information on the study design, setting, subjects, interventions, outcome measures and analyses as appropriate. **<u>Results:</u>** 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. **<u>Conclusion:</u>** 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***

(1) **Review article:** Review articles should be unstructured (no fixed format).

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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.

(5) **Abbreviations**

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.

(6) **Numbers**

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.

(7) **Units**

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.

(8) **Names of drugs, devices and other products**

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.

➢ ***References***

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.

Authors are responsible for the accuracy and completeness of their references and for correct in- text citation. If massive corrections to the references are found to be necessary in the event that your manuscript is accepted, JPI Editors reserve the right to rescind the accept decision and reject the article.

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.

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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.
- ***Acknowledgments***

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Submission List

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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）
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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.

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   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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- 附英文關鍵詞（5 個以內）；附英文簡題（長度在 40 個字以內）。
- 確認所有參考文獻的格式、內文、引用順序皆完整無誤。
- 確認所有表格（標題、註腳）及插圖之標題及詳細說明，另紙複行繕打。
- 確認所有圖表皆符合格式。圖表皆儲存於另外的檔案夾，而未放置於本文中。
- 若為人體試驗須附人體試驗委員會之同意函。
- 全部作者同意簽名之證明函。

五、稿件一經刊載，版權屬本誌所有；本誌文章皆已上載至DOI，將不另行提供抽印本。

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