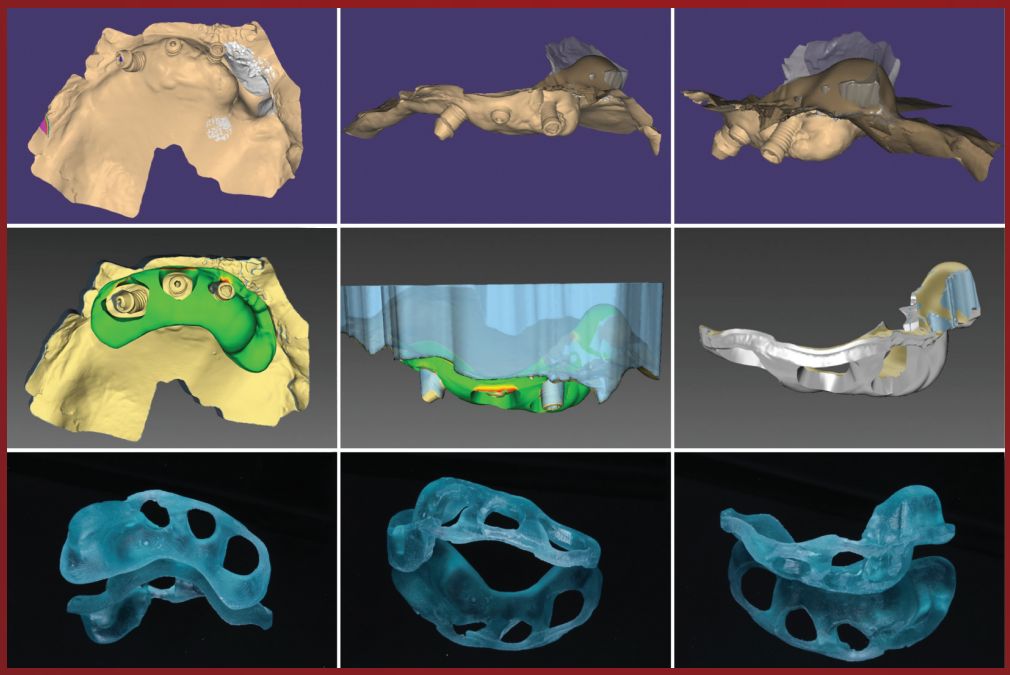
The Academy of Prosthetic Dentistry R.O.C., Taiwan

Journal of Prosthodontics and Implantology



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Editorial

In 2025, the global trends of declining birthrates and aging populations are reshaping healthcare priorities. One critical area of focus is elderly care, which presents both opportunities and challenges for dental professionals. As prosthodontists, it is essential for us to adapt by integrating emerging technologies—including implant dentistry, digital workflows, and innovations in AI, AR, and VR—into our practice. These technologies hold the potential to enhance the efficiency, safety, and quality of our care. Thus, academic, clinical, and research efforts must center on leveraging these advancements to meet evolving patient needs.

In response to these trends, the March 2025 issue of the Journal of Prosthodontics and Implantology brings together a collection of insightful studies and case reports. This edition includes two original articles and two case reports that contribute to advancing knowledge in full-mouth rehabilitation techniques.

The first original article presents a clinical retrospective study evaluating the success rates of implant-assisted removable partial dentures (IARPDs) across various clinical factors. This research offers valuable insights into optimizing outcomes for partially edentulous patients. The second original article investigates marginal bone loss in patients who have undergone implant-crown-retained removable partial denture (IC-RPD) reconstructions, providing data that can inform clinical decision-making regarding long-term implant stability.

Complementing these studies are two compelling case reports. The first highlights the design and application of Locator-bar attachments in a maxillary implant overdenture, showcasing practical considerations in attachment selection and prosthetic function. The second report details the successful use of a CAD/CAM obturator to restore the oral form and function of a patient with adenoid cystic carcinoma and restricted mouth opening. This case underscores the transformative impact of digital design in managing complex prosthetic challenges.

We are confident that the articles featured in this issue will stimulate both academic inquiry and clinical innovation. As editors, our commitment to excellence drives us to curate content that reflects the dynamic advancements within prosthodontics and implantology. We greatly appreciate feedback and suggestions from our readers, which help us continuously refine our mission to support the prosthodontic community in Taiwan and beyond.

We hope you enjoy this issue and find it both inspiring and informative.

Ting-Hsun Lan

Ting-Hsun Lan, Eiditor-in-Chief

Original Article

Clinical evaluations of implant-assisted removable partial dentures with implant surveyed crowns: A retrospective study

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Abstract

Purpose: *The aim of this retrospective study was conducted to analyze the implants success rate and complication rate of implant surveyed crown type of implant-assisted removable partial dentures(IARPD) with regard to different clinical factors.*

Materials and methods: *Patients with IARPDs categorized as surveyed crown type and under routine follow-up visits were included. Patients using attachment or healing cap types of IARPDs and not under routine follow-up visits were otherwise excluded. Overall, 16 patients, 17 dentures, 56 implants, and 35 natural teeth were examined. Implant success rates and complication rates of the subjects (dentures, implants, and natural teeth) were analyzed by multiple different factors, which were gender, age, treated arch, post-treatment Kennedy classification, implant locations, implant diameters and lengths, and crown materials. Kaplan-Meier and Cox regression model were used to analyze the success rates. Chi-square tests were used to analyze the complication rates. A p-value less than 0.05 is considered to be statistically significant.*

Results: *The mean follow-up period was 59.3 month. Overall success rate of implants was 91.1%. All subgroups showed no significant differences. 38 incidents of complication were recorded. Denture base sore spot was the most common complication (21.1%). Peri-implant mucositis was the most common complication in implant-related complication (10.5%/1 patients). Despite the complications, all the IARPDs were still functioning at the end of observation.*

Conclusion: *A 91.1% implant success rate was recorded. Different clinical factors did not have significant effects on implant success rates, but were significantly different in success rates of IARPDs and natural teeth, as well as complication rates of IARPDs and implants.*

Key words: implant surveyed crown, removable partial denture, implant success rate

Introduction

For patients with partial or complete edentulism, conventional removable dentures are considered the treatment of choice, especially for those with a limited budget.[1] However, removable dentures have several disadvantages, including a high risk of caries[1] and residual ridge resorption. According to Kordatzis et al.,[2] the estimated average reduction in posterior mandibular ridge height for implant overdentures is almost 1 mm less than that for conventional dentures, and bone levels adjacent to implants can be more favored. In addition, patients wearing Kennedy Class I or II removable partial dentures often complain of lack of stability, limited retention, and discomfort under loading.[3] Implant-assisted removable partial dentures (IARPDs), with the help of a limited number of strategically placed dental implants,[4] may improve the situation by enhancing support, retention, and stability.[3, 5-8]

IARPDs can be categorized based on implant prostheses into three types: healing cap, attachment, and surveyed crown.[9] The attachment type of IARPD has been widely used and studied and has an implant survival rate ranging from 91.7% to 100%.[10] According to Putra Wigianto et al.,[11] ball attachment is the most widely used. Previous studies have reported heterogeneous complications with ball attachments,[12-14] with replacement of plastic retentive components being the most frequently mentioned.[14] The surveyed crown type of IARPD was first described by Jang et al. in 1998,[15] who reported a single implant in the mandibular canine area supporting a surveyed crown with a removable partial denture. This implant was successful as it survived for 14 months with no bone loss. Other studies have also shown favorable results, with implant survival rates of 95.1%–100% and marginal bone losses of 0.77–1.2 mm.9,16-19 Complications of the surveyed crown type of IARPD include clasp loosening,[17, 18, 20] residual ridge resorption requiring resin base relining,[19] and dislodgement of the surveyed crowns.[16]

Implant prostheses are important clinical options in daily practice. For patients who can afford only a limited number of implants due to financial or clinical concerns, the surveyed crown type of IARPD is an alternative. Therefore, the aim of this retrospective study was to analyze the implant success rate and complication rate of surveyed crown type of IARPD in relation to different clinical factors. The null hypotheses were that different clinical factors would not result in significant differences in implant success rate and complication rate.

Materials and methods

Research Subjects

This retrospective study was approved by the Chang Gung Medical Foundation Institutional Review Board (No.202400340B0). The study included patients with partially or totally edentulous ridges who received removable partial dentures with implant-surveyed crowns since 2007 in the department of prosthodontics in Taipei Chung Gung Memorial Hospital. The inclusion criteria were as follows: patients without systemic diseases or personal habits that would affect implant osseointegration; patients with IARPDs categorized as surveyed crown type; and patients who were under follow-up for at least one year and accepted routine denture and implant check-up. The exclusion criteria were as follows: patients with IARPDs categorized as attachment or healing cap type; patients with IARPDs delivered less than a year or not under routine follow-up; and patients with inadequate ridge conditions that contraindicated implant treatment.

Sixteen patients (8 males and 8 females), with a total of 56 implants, were included in the study. Each patient's gender, age, denture experience, treated arch, and follow-up period were recorded. Figure 1 shows a representative case of implant surveyed crown–assisted removable partial denture in this study.

Success rate analysis

The main outcomes of the study were success rates. Implant success, as the optimum condition, was defined according to the ICOI Pisa Implant Quality of Health Scale: no pain or tenderness upon function; 0 mobility; <2 mm radiographic bone loss from initial surgery; and no history of exudates. Implant survival refers to implants being still functional but not in ideal condition. A failed implant is one that should be or has already been removed.[21]

The diagnosis of implant diseases was based on the guideline defined in the 2017 Workshop : peri-implant mucositis, defined as the presence of bleeding and/or suppuration on gentle probing, with or without increased probing depth compared to previous examinations, and the absence of bone

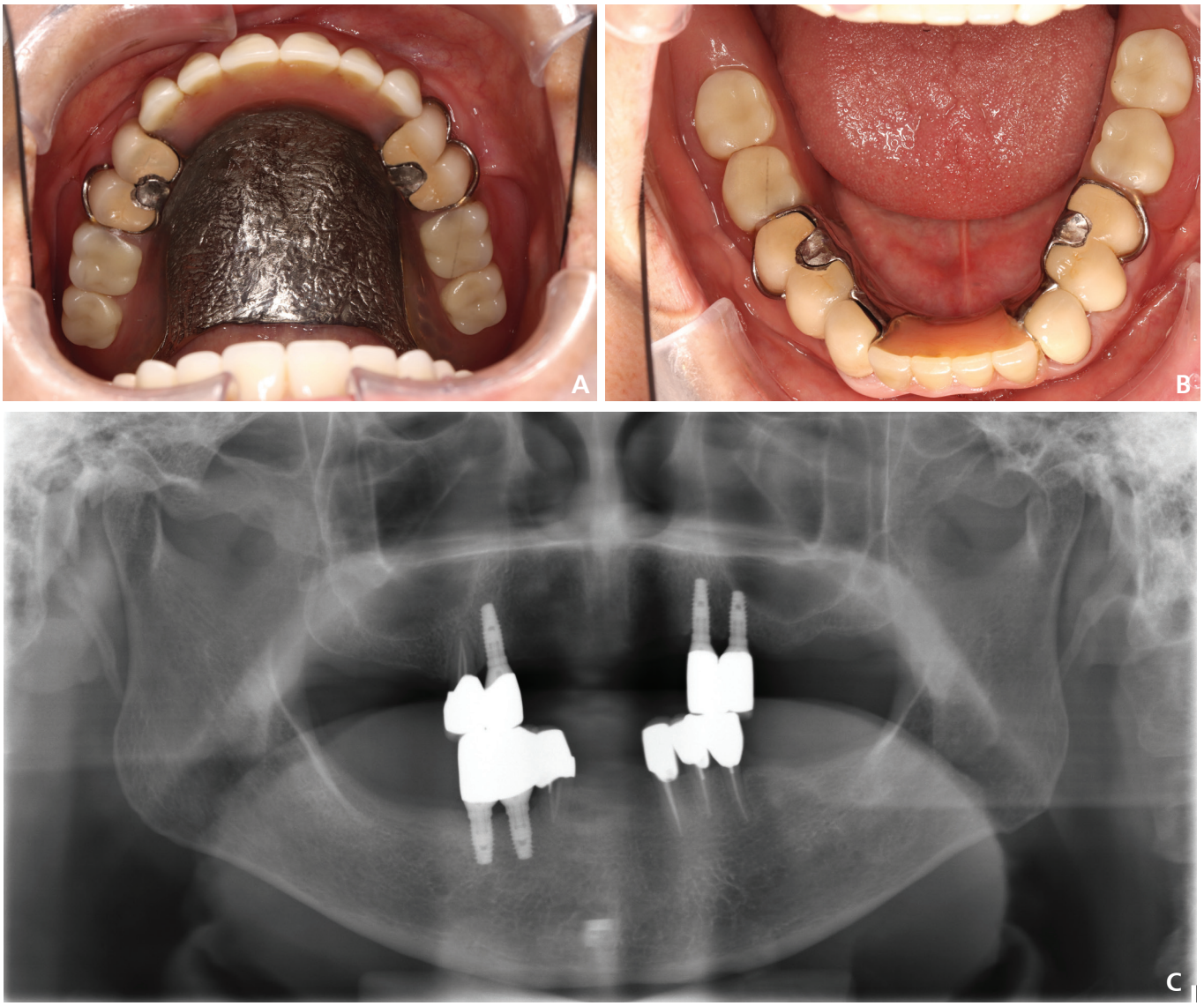

Figure 1. A representative case of implant surveyed crown type of IARPD in the study.
(A) Maxillary arch treated with #15 nature teeth and #14,24,25 implant surveyed crowns.
(B) Mandibular arch treated with #33,34,35,43 nature teeth and #44,45 implant surveyed crowns. Implant assisted removable partial dentures were used in both arches.
(C) Panoramic film of the patient.

loss beyond crestal bone level changes resulting from initial bone remodeling; and peri-implantitis, defined as the presence of bleeding on probing and/or suppuration, increased probing depth, and the presence of detectable bone loss exceeding the measurement error (a mean of 0.5 mm).[22]

The success of IARPDs and natural teeth abutments was also evaluated. Successful IARPDs and natural teeth were defined as those with no complications, whereas surviving IARPDs and natural teeth were defined as those having complications but were still functional at the last follow-up appointment.

Modifying factors

The success rates and complication rates of implants, IARPDs, and natural teeth were calculated and analyzed in relation to multiple factors, including gender, age, treated arch, opposing arch, post-treatment Kennedy classification, implant location, implant diameter and length, and crown material.

Complications

CComplications were recorded and divided into four subgroups as follows:[9, 16-20, 23]

denture-related complications, including fracture of artificial teeth, clasps, rests, or denture base and clasp loosening; implant-related complications, including peri-implant mucositis, peri-implantitis, retention loss, porcelain fracture, and implant loss; complications involving natural

teeth abutments, including pulp or apical involvement indicating endodontic treatment, caries, tooth fracture, periodontitis, and tooth loss; and complications involving soft tissue, such as sore spots under denture base bearing areas.

The time to occurrence of complication was calculated in months as the time from the delivery of prostheses to the occurrence of incident. Multiple complications classified in different subgroups of the same prostheses were calculated separately, whereas repeated complications of the same prostheses were measured once at the time of the first event.[23]

Statistical analysis

All data were analyzed using SPSS statistical software (IBM SPSS Statistic, v29.0.1.0; IBM Corp., New York, US). Chi-square tests were performed to analyze complications of the different subgroups—IARPDs, implants, and natural teeth. Fisher's exact test was used when more than 20% of the expected count was less than 5 or the minimum expected count was less than 1. The Kaplan–Meier method and Cox regression were used to analyze the success rates. The time interval in Kaplan–Meier and Cox regression were defined as months from the delivery of prostheses to the first occurrence of complication or the end of observation. Mean estimated months to occurrence of complication were calculated and analyzed using the logrank (Mantel–Cox) test. Cox regression results are presented as hazard ratios and 95% confidence intervals (CIs). A p-value less than 0.05 was considered statistically significant, and G*Power statistical software (Erdfelder, Faul, & Buchner, 1996) was then used to determine the post-hoc statistical power.

Results

A total of 56 implants in 16 patients (8 males and 8 females) with a mean age of 73.25 (ranged 53–93) years were examined. One patient had both arches treated with implant surveyed crown type of IARPD; therefore, 17 arches were included. The mean follow-up period was 59.3 months. Patient and implant data are presented in Table 1. Kennedy Class I was the most common classification before and after treatment (52.9%). Fifty-six implants and 35 natural teeth were used as abutments for the 17 dentures. Of the 56 implants, 36 (64.3%) were in the maxilla and 20 (35.7%) were in the mandible. Implants were mostly located in the premolar region (58.9%). The majority of the implant prostheses were made of porcelain-fused-to-metal material (89.3%). Of the 35 natural teeth, 16 (45.7%) were in the maxilla and 19 (54.3%) were in the mandible. The remaining natural teeth were mostly premolars (51.4%). The distribution of each subgroup is presented in Table 2.

Success rate analysis

The overall success rate of IARPDs was 47.1%, with nine arches experiencing complications. The results of the Kaplan–Meier and Cox regression analyses of the IARPDs are shown in Table 3. No significant difference was found in post-treatment Kennedy classification, opposing arch, and implant prostheses positions groups. The mean estimated time to complication occurrence was significantly different for treated arches (p = .008; G*Power = 83.5%), and mandibular IARPDs had a significantly higher risk of complications (hazard ratio [HR] = 5.999; p = .029).

The overall success rate of implants was 91.1%, with four implants having peri-implant mucositis and one having peri-implantitis. Table 4 provides specific information about these five implants. The subgroups did not show significant differences (Table 5) . The overall success rate of natural teeth was 74.3%, with nine natural teeth experiencing complications. One premolar was extracted and the other eight teeth were still functioning at the end of observation. Mean estimated time to complication occurrence was significantly different for the opposing arch group (p = .006; G*Power = 31.22%). Natural teeth opposing the complete denture or overdenture had a significantly higher risk of complication (HR = 10.285; p = .034; Table 6).

Complications

During the observation period, 38 complication incidents were recorded. Sore spot under the denture base was the most common complication (21.1%). Table 7 shows a list of complications, including their incidences, average time to occurrence, and related treatments. Among denture-related complications, fracture of artificial teeth was the most common (7.9% /3 patients). No rest fracture was observed. Peri-implant mucositis was the most common implant-related complication (10.5%/1 patient). One implant

Table 1. Data of patients and implants

				Kennedy classification			RPD implant abutments		RPD natural teeth abutments		Follow-up period (month)
Participant	Gender	Age (y/o)	Treated arch	Pre-treatment	Post-treatment	Opposing dentition	Number	location	Number	location	
1	F	61	Mx	II	IV	Natural dentition and implant FPD	5	#13, 15, 17, 25, 26	2	#27, 28	61
2	M	73	Mx	Edentulous	IV	Natual dentition and implant FPD	6	#13, 15, 17, 24, 25, 26	0	0	40
3	M	53	Mx	II mod. 1	IV	Natural dentition and implant FPD	5	#13, 15, 16, 26, 27	3	#17, 24, 25	158
4	F	72	Mn	I	I mod. 1	CD	2	#34, 35	3	#43, 44, 45	104
5	M	84	Mx	I mod. 1	II mod. 1	Natural dentition and FPD	2	#15, 16	7	#11-14, 21, 23, 24	118
6	F	68	Mn	I	I mod. 1	CD	3	#43, 44, 46	3	#33, 34, 35	37
7	M	62	Mx	Edentulous	IV	Natural dentition	4	#15, 16, 24, 26	0	0	15
8	F	77	Mn	Edentulous	I mod. 1	Overdenture	2	#34, 43	0	0	36
9	F	77	Mn	I mod. 1	I mod. 1	CD	1	#34	4	#33, 43, 44, 45	19
10	F	75	Mn	I	I mod. 1	Overdenture	2	#33, 44	0	#34	40
11	F	67	Mx	I	I mod. 1	IARPD	3	#14, 24, 25	1	#15	60
11	F	67	Mn	I mod. 1	I mod. 1	IARPD	2	#44, 45	4	#33, 34, 35, 43	60
12	F	93	Mn	I	I mod. 1	CD	2	#34, 35	2	#44, 45	60
13	M	85	Mx	II mod. 1	IV	Natural dentition and implant FPD	3	#25, 26, 27	3	#14, 15, 17	27
14	M	66	Mx	Edentulous	IV	Implant FPD	4	#14, 15, 23, 25	0	0	27
15	M	74	Mx	Edentulous	I mod. 1	Implant overdenture	4	#14, 15, 22, 24	0	0	98
16	M	85	Mn	I mod. 1	IV	Natural dentition and implant FPD	4 2	#34, 35, 44, 46 45 47	2	#33, 43	77 (IARPD) 15(#44-x-46) 49(#45-x-47)

Table 2. Distribution of patients, IARPDs, implants and natural teeth

Patients		IARPDs		Implants		Natural teeth	
Overall	16 patients	Overall	17 arches	Overall	56 implants	Overall	35 natural teeth
Gender		Treated arch		Treated arch		Treated arch	
Male	8 (50%)	Maxilla	9 (52.9%)	Maxilla	36 (64.3%)	Maxilla	16 (45.7%)
Female	8 (50%)	Mandible	8 (47.1%)	Mandible	20 (35.7%)	Mandible	19 (54.3%)
Age (y/o)	Mean: 73.25	Pre-treatment Kennedy		Implant location		Natural teeth location	
<65	3 (18.75%)	Edentulous	5 (29.4%)	Anterior	8 (14.3%)	Anterior	13 (37.1%)
>65	13 (81.25%)	I	9 (52.9%)	Premolar	33 (58.9%)	Premolar	18 (51.4%)
		II	3 (17.6%)	Molar	15 (26.8%)	Molar	4 (11.4%)
Denture experience		Opposing arch		Implant diameter		Opposing arch	
Yes	13 (81.25%)	Natural dentition/ FPDs	8 (47.1%)	3.25mm	14 (25%)	Natural teeth/FPDs	17 (48.6%)
No	3 (18.75%)	CD/Overdenture	6 (35.3%)	4mm	33 (58.9%)	CD/overdenture	13 (37.1%)
		IARPD	3 (17.6%)	5mm	9 (16.1%)	IARPD	5 (14.3%)
Treated arch		Number of abutments		Implant length		Post-treatment Kennedy	
Maxilla	8 (50%)	Natural teeth	35	6.5mm	2 (3.6%)	I	18 (51.4%)
Mandible	7 (43.75%)	Implants	56	8.5mm	8 (14.3%)	II	7 (20%)
Both	1 (6.25%)			10mm	21 (37.5%)	IV	10 (28.6%)
				11.5mm	25 (44.6%)		
Follow-up period (month)	Mean: 59.3	Post-treatment Kennedy		Post-treatment Kennedy			
12~60	10 (62.5%)	I	9 (52.9%)	I	21 (37.5%)		
60~120	5 (31.25%)	II	1 (5.9%)	II	2 (3.6%)		
>120	1 (6.25%)	IV	7 (41.1%)	IV	33 (58.9%)		
				Material			
				PFM	50 (89.3%)		
				Full zirconia	6 (10.7%)		

Table 3. Success analysis of IARPDs

				Kaplan-Meier		Cox regression		
	Number of IARPDs	Number of IARPDs with complications	Success rate	Mean estimated time of complication occurrence (month)	*p*-value (log-rank test)	95% CI	Hazard Ratio	*p*-value
Overall included	17	9	47.1%					
Treated arch								
Maxilla	9	2	77.8%	124	.008*		1	
Mandible	8	7	12.5%	13		1.196-30.099	5.999	.029*
Post-treatment Kennedy								
I	9	6	33.3%	36.2	.105		1	
II	1	1	0	1		.309-25.944	2.829	.358
IV	7	2	71.4%	116.3		.066-1.658	.331	.179
Opposing arch								
Natural dentition/FPDs	8	3	62.5%	101.9	.167		1	
CD/overdenture	6	5	16.7%	14.7		.697-12.626	2.966	.141
IARPD	3	1	66.7%	65.7		.088-8.291	.855	.892

*: *p* value less than 0.05, statistically significant

Table 4. The specific information of the implants with peri-implant mucositis or peri-implantitis

Patient	A	B
Gender/Age (y/o)	M/74	M/85
Complication/time of occurrence (month)	Peri-implant mucositis/74	Peri-implantitis/15
Location	#14, 15, 22, 24	#46
Post-treatment Kennedy	Class I mod. 1	Class IV
Implant diameter/length(mm)	14 (4x10); 15 (4x10); 22 (3.25x11.5); 24(4x11.5)	4x8.5
Opposing dentition	#34, 44 implant with ERA overdenture	Natural teeth, FPDs, implants
Related treatment	OHI, routine dental follow-up, and SPIT	Separate #44-x-46 implant bridge and #46 implant removal

Table 5. Success analysis of implants

				Kaplan-Meier		Cox regression		
	Number of implants	Number of successful implants	Success rate	Mean estimated time of complication occurrence (month)	*p*-value (log-rank test)	95% CI	Hazard Ratio	*p*-value
Overall included	56	51	91.1%					
Treated arch								
Maxilla	36	32	88.9%	127.5	.526		1	
Mandible	20	19	95%	99.6		.059-4.724	.527	.567
Implant location								
Anterior	8	7	87.5%	116.0	.858		1	
Premolar	33	30	90.9%	132.8		.065-6.006	.624	.683
Molar	15	14	93.3%	148.5		.032-8.107	.507	.631
Implant diameter								
3.25mm	14	13	92.9%	130			1	
4mm	33	29	87.9%	123.1	.263	.172-13.772	1.539	.700
5mm	9	9	100%	---		.000	.000	.983
Implant length								
6.5mm	2	2	100%	---	.898	.000	.000	.992
8.5mm	8	7	87.5%	92.9		.137-16.691	1.513	.735
10mm	21	19	90.5%	134		.128-6.510	.914	.928
11.5mm	25	23	92%	130			1	
Post-treatment Kennedy								
I	21	17	81%	84	.096		1	
II	2	2	100%	---		.000	.000	.993
IV	33	32	97%	153.7		.202-1.623	.181	.127
Materials								
PFM	50	45	90%	134.6	.729		1	
Full zirconia	6	6	100%	---		.000-4.895E+10	.042	.823

(#46) experienced peri-implantitis after 15 months of loading and had to be removed. The failed implant was separated from the old implant bridge (#44-x-46), and a new implant bridge (#45-x-47) was fabricated. Among natural-teeth-related complications, periodontitis was the most common (13.2%/2 patients). In the case of tooth failure, one residual natural tooth (#34) was extracted seven months after denture delivery. Despite the complications, all the IARPDs were still functioning at the end of observation.

Tables 8–10 show the results of the chi-square and Fisher's exact tests of the different subgroups. At the denture level, the mandibular arch had a significantly higher complication rate in terms of denture sore spot (75%; p = .015; G*Power = 83.67%). At the implant level, the complication rate for retention loss was significantly different for treated ach (p = .013; G*Power = 79.39%) and implant length (p = .011; G*Power = 82.85%). The complication rate for peri-implant mucositis was significantly different between post-treatment Kennedy classes (p = .027; G*Power = 66.71%). At the natural teeth level, no significant differences were observed.

Discussion

The results of this study confirmed the null hypothesis that different clinical factors of surveyed crown type of IARPD would not result in significant differences in implant success rate but rejected the null hypothesis that complication rates would not be significantly different. The success rate of IARPDs in this study was 47.1%. This is lower than a previously reported success rate of 66.7% for IARPDs.[23] The Kaplan–Meier and Cox regression analyses showed that the patients whose mandibular arch was treated had a significantly higher risk of complications (Table 3). This is inconsistent with the results of a previous study that reported that the mandibular arches had a higher success rate.[23]

Tissue sore spots were the most common complication (Table 8), a result consistent with those of other studies.[17,19,20] In the present study, 75% of the mandibular arches had tissue sore spots, a significantly higher incidence than that observed for maxillary arches (p = .015; G*Power = 83.67%), which possibly led to the higher risk of complications. In addition, according to Yi et al., Kennedy Class II has the highest risk of complications, and IARPDs in Classes I and II show lower success rates than those in Classes III and IV.[23] Similar outcomes were found in this study, with a success rate of 33%, 0%, and 71.4% for Class I, II, and IV, respectively, although this was not a significant result. No other factors significantly influenced success rates.

Overall, of the 56 implants in this study, 51 did not show pain or tenderness during functioning or mobility, showed a radiographic bone loss of less than 2 mm, and had no history of exudates. These 51 implants were considered successful according to the ICOI Pisa Implant Quality of Health Scale,[21] resulting in a 91.1% success rate. This rate is comparable to those reported in other studies: a 90.6% success rate for 32 implants;[24] and an 85.1% success rate for 70 implants.[20]. In the case of implant survival rate, four implants diagnosed with peri-implant mucositis were still functioning at the end of observation, leading to a 98.2% survival rate in this study. This rate is consistent with the 95.1%–100% survival rates reported in other studies.[9,16-20,24] No significant differences were found in survival rate between the factors analyzed in the Kaplan–Meier and Cox regression analyses (Table 5). In a previous study, the survival rate of regular diameter implants was significantly higher than that of narrow (<3.75 mm) and wide (≥5 mm) diameter implants[16], and the study concluded that implants with a wide diameter are not more advantageous than implants with a regular diameter.[25] In the present study, implant width did not have a significant effect on the survival rate (p = .263). In the case of complications, retention loss was found to be significantly higher for the mandibular arch (p = .013; G*Power = 79.39%) and 6.5-mm implant length (p = .011; G*Power = 82.85%; Table 9). The four implants suffering from retention loss were in the same patient and supported #34-35 and #44-x-46 temporarily cemented prostheses (TempBond™, Kerr, California, United States). These prostheses were able to be re-cemented.

In addition to implants, we also evaluated the remaining natural teeth in the IARPDs. In a previous study, natural abutments in IARPDs had a survival rate of 96.6%. The five failed teeth were thought to experience excessive loading, being occluding stops to implants or natural dentition. The mean bone loss of abutment teeth in the maxilla and of teeth with direct retainers was significantly higher. Teeth with direct retainers were assumed to withstand higher lateral force

Table 6. Success analysis of natural teeth

				Kaplan-Meier		Cox regression		
	Number of natural teeth	Number of natural teeth with complications	Success rate	Mean estimated time of complication occurrence (month)	*p-value* (log-rank test)	95% CI	Hazard Ratio	*p*-value
Overall included	35	9	74.3%					
Treated arch								
Maxilla	16	4	75%	125.6	.155		1	
Mandible	19	5	73.7%	65.8		.578-17.499	3.180	.184
Natural teeth location								
Anterior	13	3	76.9%	97.1	.369		1	
Premolar	18	6	66.7%	87.4		.421-6.841	1.698	.456
Molar	4	0	100%	---		.000	.000	.985
Opposing arch								
Natural dentition/FPDs	17	4	76.5%	127.6	.006*		1	
CD/overdenture	13	5	61.5%	51.8		1.189-88.949	10.285	.034*
IARPD	5	0	100%	---		.000	.000	.984
Post-treatment Kennedy								
I	18	5	72.2%	54.6	.178		1	
II	7	2	71.4%	98.6		.013-1.750	.150	.130
IV	10	2	80%	114.7		.020-1.918	.195	.161

*: *p* value less than 0.05, statistically significant

Table 7. List of complications

	Complications	Incidences/Patients	Average time of occurrence	Related treatments
Total incidents of complication: 38				
Denture	Fracture of artificial teeth	3 (7.9%)/3	26	Direct acrylic repair/ Pick up impression and repair
	Fracture of RPD clasp	2 (5.3%)/2	24.5	Pick up impression and repair/ Rounding and polishing
	Fracture of RPD rest	---	---	---
	Clasp loosening	2 (5.3%)/2	11.5	Clasp adjustment
	Denture base fracture	1 (2.6%)/1	3	Rounding and polishing
Implant	Peri-implant mucositis	4** (10.5%)/1	74	OHI and SPIT
	Peri-implantitis	1 (2.6%)/1	15	Cut #44-x-46 bridge and #46 implant removal
	Retention loss	2 (5.3%)/1	9	#44-x-46 and #34-35 re-cementation
	Porcelain veneer fracture	2 (5.3%)/1	66.5	Rounding and polishing
	Implant loss	1 (2.6%)/1	15	Cut #44-x-46 bridge and #46 implant removal
Natural teeth abutments	Endodontic treatment	1 (2.6%)/1	147	#25 endodontic treatment
	Fracture	1 (2.6%)/1	64	Direct composite filling
	Caries	4 (10.5%)/3	66.8	Direct composite filling
	Periodontitis	5 (13.2%)/2	71.3	Localized root planing
	Tooth loss	1 (2.6%)/1	7	#34 residual root and extraction
Tissue	Denture base sore spot	8 (21.1%)/7	9	Denture adjustment and relief pressure spots

*: *p* value less than 0.05, statistically significant

Table 8. Details of complications of IARPDs

Complication rate: 9/17 (52.9%)		Treated arch			Post-treatment Kennedy				Opposing arch			
Complication types	**No. of IARPDs**	**Maxillary (9)**	**Mandible (8)**	***p***	**I (9)**	**II (1)**	**IV (7)**	***p***	**Natural dentition/ FPDs (8)**	**CD/ overdenture (6)**	**IARPD (3)**	***p***
Denture												
Artificial teeth	3 (17.6%)	2 (22.2%)	1 (12.5%)	1.000	1 (11.1%)	1 (100%)	1 (14.3%)	.228	2 (25%)	1 (16.7%)	0	1.000
Clasp fracture	2 (11.8%)	1 (11.1%)	1 (12.5%)	1.000	1 (11.1%)	1 (100%)	0	.118	1 (12.5%)	1 (16.7%)	0	1.000
Clasp loosening	2 (11.8%)	0	2 (25%)	.206	2 (22.2%)	0	0	.537	0	2 (33.3%)	0	.132
Denture base	1 (5.9%)	0	1 (12.5%)	.471	1 (11.1%)	0	0	1.000	0	0	1 (33.3%)	.176
Implant												
Peri-implant mucositis	1 (5.9%)	1 (11.1%)	0	1.000	1 (11.1%)	0	0	1.000	0	0	1 (33.3%)	.176
Peri-implantitis	1 (5.9%)	0	1 (12.5%)	.471	0	0	1 (14.3%)	.471	1 (12.5%)	0	0	1.000
Retention loss	1 (5.9%)	0	1 (12.5%)	.471	0	0	1 (14.3%)	.471	1 (12.5%)	0	0	1.000
Porcelain veneer fracture	1 (5.9%)	1 (11.1%)	0	1.000	0	0	1 (14.3%)	.471	1 (12.5%)	0	0	1.000
Implant loss	1 (5.9%)	0	1 (12.5%)	.471	0	0	1 (14.3%)	.471	1 (12.5%)	0	0	1.000
Natural teeth												
Endo	1 (5.9%)	1 (11.1%)	0	1.000	0	0	1 (14.3%)	.471	1 (12.5%)	0	0	1.000
Fracture	1 (5.9%)	1 (11.1%)	0	1.000	0	1 (100%)	0	.059	1 (12.5%)	0	0	1.000
Caries	3 (17.6%)	2 (22.2%)	1 (12.5%)	1.000	1 (11.1%)	1 (100%)	1 (14.3%)	.228	2 (25%)	1 (16.7%)	0	1.000
Periodontal	2 (11.8%)	1 (11.1%)	1 (12.5%)	1.000	1 (11.1%)	1 (100%)	0	.118	1 (12.5%)	1 (16.7%)	0	1.000
Tooth loss	1 (5.9%)	1 (11.1%)	0	.471	1 (11.1%)	0	0	1.000	0	1 (16.7%)	0	.529
Tissue												
Sore spots	7 (41.2%)	1 (11.1%)	6 (75%)	.015*	5 (55.6%)	1 (100%)	1 (14.3%)	.134	2 (25%	4 (66.7%)	1 (33.3%)	.377

*: *p* value less than 0.05, statistically significant

Table 9. Details of complications of implants

	Complication types				
Complication rate: 10/56 (17.9%)	**Peri-implant mucositis**	**Peri-implantitis**	**Retention loss**	**Porcelain veneer fracture**	**Implant loss**
Number of implants	4 (7.1%)	1 (1.8%)	4 (7.1%)	2 (3.6%)	1 (1.8%)
Treated arch					
Maxillary (36)	4 (11.1%)	0	0	2 (5.6%)	0
Mandibular (20)	0	1 (5%)	4 (20%)	0	1 (5%)
p	.285	.357	.013*	.532	.357
Implant location					
Anterior (8)	1 (12.5%)	0	0	0	0
Premolar (33)	3 (9.1%)	0	3 (9.1%)	0	0
Molar (15)	0	1 (6.7%)	1 (6.7%)	2 (13.3%)	1 (6.7%)
p	.454	.411	1.000	.086	.411
Materials					
PFM (50)	4 (8%)	1 (2%)	4 (8%)	2 (4%)	1 (2%)
Full zirconia (6)	0	0	0	0	0
p	1.000	1.000	1.000	1.000	1.000
Implant diameter					
3.25mm (14)	1 (7.2%)	0	0	0	0
4mm (33)	3 (9.1%)	1 (3%)	2 (6.1%)	1 (3%)	1 (3%)
5mm (9)	0	0	2 (22.2%)	1 (11.1%)	0
p	1.000	1.000	.161	.357	1.000
Implant length					
6.5mm (2)	0	0	1 (50%)	0	0
8.5mm (8)	0	1 (12.5%)	2 (25%)	0	1 (12.5%)
10mm (21)	2 (9.5%)	0	1 (4.8%)	1 (4.8%)	0
11.5mm (25)	2 (8%)	0	0	1 (4%)	0
p	1.000	.179	.011*	1.000	.179
Post-treatment Kennedy					
I (21)	4 (19%)	0	0	0	0
II (2)	0	0	0	0	0
IV (33)	0	1 (3%)	4 (12%)	2 (6.1%)	1 (3%)
p	.027*	1.000	.267	.550	1.000

*: *p* value less than 0.05, statistically significant

Table 10. Details of complications of natural teeth

	Complication types				
Complication rate 9/35 (25.7%)	**Endodontic**	**Caries**	**Fracture**	**Periodontal**	**Tooth loss**
Number of natural teeth	1 (2.9%)	4 (11.4%)	1 (2.9%)	5 (14.3%)	1 (2.9%)
Treated arch					
Maxillary (16)	1 (6.3%)	3 (18.8%)	1 (6.3%)	2 (12.5%)	0
Mandibular (19)	0	1 (5.3%)	0	3 (15.8%)	1 (5.3%)
p	.457	.312	.457	1.000	1.000
Natural teeth location					
Anterior (13)	0	1 (7.7%)	1 (7.7%)	3 (23.1%)	0
Premolar (18)	1 (5.6%)	3 (16.7%)	0	2 (11.1%)	1 (5.6%)
Molar (4)	0	0	0	0	0
P	1.000	.772	.486	.657	1.000
Opposing arch					
Natural dentition/ FPDs (17)	1 (5.9%)	3 (17.6%)	1 (5.9%)	2 (11.8%)	0
CD/ Overdenture (13)	0	1 (7.7%)	0	3 (23.1%)	1 (7.7%)
IARPD (5)	0	0	0	0	0
P	1.000	.797	1.000	.537	.514
Post-treatment Kennedy					
I (18)	0	1 (5.6%)	0	3 (16.7%)	1 (5.6%)
II (7)	0	1 (14.3%)	1 (14.3%)	2 (28.6%)	0
IV (10)	1 (10%)	2 (20%)	0	0	0
P	.486	.399	.200	.247	1.000

than teeth with indirect retainers.[20] A total of 35 teeth were included in the study and a success rate of 74.3% was reported. The success rate was lower than that of another previous study,[20] but eight of the nine teeth with complications were still functioning at the end of observation, showing a comparable 97.1% survival rate. Table 6 shows that natural teeth occluding a complete denture or overdenture had significantly higher risks of failure (HR = 10.285; $p = .034$) in this study. One tooth occluding a complete denture was extracted seven months after delivery. This was in order to save the tooth with the poor prognosis to maintain vertical dimension; the tooth was able to be extracted after completion of the final prosthesis.

A limitation of the present study is its small sample size, which might have affected statistical power and caused bias. Post-hoc tests of mean estimated time to occurrence of complications in natural teeth opposing arch groups (G*Power = 31.22%) and of the complication rate of implants with peri-implant mucositis in post-treatment Kennedy classification groups (G*Power = 66.71%) had a power lower than the ideal power of 80%; therefore, these results should be interpreted with caution. In addition, clinical information on implants, such as marginal bone loss, soft tissue condition, and patient-reported outcome measures were not analyzed. Furthermore, five patients were edentulous before treatment. Previous studies showed that in edentulous patients, the implant survival rates of implant surveyed crown type of IARPD were comparable to those of implant overdentures with attachments.[16-18] These factors should be considered in future studies to confirm the clinical feasibility of surveyed crown type of IARPD.

Conclusion

Within its limitations, this study reports a 91.1% implant success rate. Surveyed crown type of IARPD could be a viable treatment option for totally or partially edentulous patients. Different clinical factors did not have significant effects on the success rate of implants, but had significant impacts on the success rates of IARPDs and natural teeth. In addition, these factors had significant effects on the complication rates of IARPDs and implants. Further clinical studies are necessary to confirm these results.

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Original Article

Clinical evaluation of marginal bone loss of implant-crown-retained removable partial dentures: A retrospective study

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Running title: implant marginal bone loss of implant-crown-retained removable partial dentures

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Abstract

Purpose: *the aim of this study is to evaluate the marginal bone loss of implants in those patients who had implant-crown-retained removable partial denture (IC-RPDs) reconstruction and to confirm the feasibility of IC-RPDs using for partial or complete edentulous patients.*

Materials and methods: *17 IC-RPDs with 72 implant crowns in 16 patients (8 males and 8 females) were enrolled in the study. Marginal bone loss (MBL) of implants was analyzed based on multiple variables including gender, smoking or not, implant location, restored arch, type of opposing arch, splinting implant crown or not, implant as RPD abutment or not, implant diameter, and bone graft or not. To identify the categorical variables significantly associated with MBL, t-test and one-way ANOVA were used to analysis. Significance level $p < .05$ was used for all tests. G power analysis was used as post hoc test. Power ≥ 0.8 defined as clinically meaningful.*

Results: *During mean follow up period of 63.24 month, 1 of 72 implants failed after functional loading for 24 months. When implants were stratified by gender and bone graft, a statistically significant relation could be observed. No significant difference could be observed in the following variables: smoking or not, restored arch, type of opposing arch, splinting implant crown or not, implant as RPD abutment or not, implant diameter.*

Conclusion: *Implant crown used as abutments of RPD is feasible. For the variables above, implants in bone grafted area showed more MBL than in pristine bone and male showed more MBL than female. However, all of the implants marginal bone loss within the normal limits, except the failure one. Original Article: a retrospective study.*

Key words: implant-crown-retained removable partial denture (IC-RPD); marginal bone loss (MBL)

Introduction

According to a survey by Taiwan's Ministry of Health and Welfare in 2016, patients older than 65 years have an average of 18.61 teeth in the mouth, which means that removable partial dentures (RPDs) are an appropriate treatment option for this cohort. However, the condition of the remaining teeth and residual roots is frequently unsuitable for conventional RPDs. For such people, implant-assisted RPDs (IARPDs) may be an alternative choice.

Implant-assisted RPDs include implant overdentures (IODs) and implant-crown-retained removable partial dentures (IC-RPDs). Implants and RPDs have been used in combination for decades.[1,2] This treatment modality is widely accepted and has excellent outcomes. IARPDs improve prostheses retention, stability, occlusal force, and patient satisfaction.[3–5] The long-term survival rates of IARPDs have been assessed in many studies. In their systematic review of 2021, Wigianto et al. found implant survival rates ranging from 91% to 100%.[6] Bassetti et al. in their 2018 critical review of selected literature found implant survival rates of 91.7%–100%.[7] In addition to their highly successful clinical outcomes, IARPDs are a more economical treatment modality, as only a small number of implants is required to achieve these results.[8–10]

While most previous studies on IARPDs discussed IODs, few considered IC-RPDs. In their 2020 study, Kang et al. compared IODs and IC-RPDs and found that the survival rate of IC-RPDs was higher.[11] In Yoo et al.'s 2021 study, IARPDs for the maxilla and mandible were considered. In the maxilla, the implant survival rate of IC-RPDs was 97.3% and that of IODs was 70.4%; in the mandible, it was 98.3% and 83.1%, respectively.[12,13] Since IC-RPDs have been found to have a better clinical prognosis than IODs in recent studies and their design concept is comparable to that of conventional RPDs, it may be easy for dentists to grasp the principles of this therapy.

The International Congress of Oral Implantologists (ICOI) Consensus Conference for Implant Success in Pisa in 2007 classified the dental implant quality of health scale into four categories: success, satisfactory survival, compromised survival, and failure.[14] The diagnosis of the implant's quality of health category is based on clinical indices of pain, mobility, radiographic crestal bone loss, and probing depth. Unfortunately, when pain or implant mobility is present, removal of the implant is usually indicated. Routine probing is not necessary unless there are signs or symptoms. Radiographic crestal bone loss is easy to determine during routine examination. In addition, the importance of maintaining stable bone levels around oral implants is generally accepted. Adell et al. determined that the mean bone loss for Branemark Osseointegrated Implants was 1.5 mm in the first year.[15] Success criteria established as acceptable include an annual bone loss of less than 0.2 mm in subsequent years without clinical signs of peri-implant infection.[16]

Marginal bone loss (MBL) of implants is a key element in the discussion on implant survival or success. Therefore, the aim of this study was to evaluate implant MBL in patients who underwent reconstruction with IC-RPDs and to confirm the feasibility of using IC-RPDs for partially or completely edentulous patients.

Materials and methods

TPatients treated with IC-RPDs at Taipei Chang Gung Memorial Hospital from 2007 to 2021 and had a regular follow-up were enrolled. All participants wore IC-RPDs for at least 12 months. Patients who had a systemic disease which was under control were not excluded. Sixteen patients (8 males and 8 females) with a total of 17 IC-RPDs were enrolled in the study. Nine of the IC-RPDs were in the maxilla and eight were in the mandible. One patient was treated with IARPDs in both arches. The patients' mean age was 73.2 ± 10.3 years, and the follow-up period was 63.24 ± 45.51 months (a maximum of 196 months). All 72 implants were the same system (BIOMET 3i) and internal connection type and the implant crowns were cement type. Each patient's gender, restored arch (maxilla or mandible), Kennedy classification, the number of implants as RPD abutments, implant diameter (narrow, normal, or wide), whether or not the implant crown was splinted, the need for graft or whether pristine bone, the number of failed implants, and opposing dentition were recorded (Table 1).

Nine of the 17 IC-RPDs were Kennedy Class I modification 1 (53%), seven were Kennedy Class IV (41%), and one was Kennedy Class III (6%). Fifty-four of the 72 implant crowns were RPD abutments. The guiding plane, rest, and the placement of the clasp were designed according to implant location. For example, the implants placed

in the maxilla were splinted and designed as RPD abutments (Figure 1). The opposing arch was one of three types: fixed dentition (natural teeth and implants), removable denture (complete denture, overdenture, or RPD),or IC-RPD . Implant diameter was classified as narrow type (< 3.75 mm), normal type (≥ 3.75 mm and < 5 mm), and wide type (≥ 5 mm).

Definition of marginal bone loss

All patients were radiographically examined throughout the different clinical phases and at the time of regular follow-up every year. The momentary rate of MBL around the implant was measured as the difference in bone levels at two visits divided by the number of years between the visits.[17] The time of implant functional loading was calculated as the time elapsed from the time of temporary crown delivery. The times of the two visits in the formula were the time of implant functional loading and the time of the last recall visit. To calculate the actual MBL, we took linear measurements of each periapical radiograph from the most distal and mesial side of the implant platform to the crestal bone. The magnification of the radiographs was corrected in accordance with the actual implant length, and the actual bone level was calculated using the proportional equation shown in Figure 2.

Statistical analysis

Data were analyzed using SPSS Statistics 29.0.1 and G power 3.1.9.7. The t-test and one-way ANOVA were used to identify the categorical independent variables with a significant effect on MBL. The independent variables included gender, whether or not smoking, implant location, restored arch, type of opposing arch, whether or not the implant crown was splinted, whether or not the implant was an RPD abutment, implant diameter, and whether or not a bone graft was performed. The null hypothesis was that there was no relationship between MBL and the above independent variables. The significance level of $p <$ .05 was used for all tests. If the null hypothesis was rejected in the analysis of variance, G power analysis was used as the post-hoc test. The power level was calculated using the given sample, the effect size, and the desired significance level. A power of ≥ 0.8 was defined as clinically meaningful.

Table 1. Data on participants and implants (M: Male, F: Female, Mx: Maxilla, Mn: Mandible, V: Yes, X: No, CD: complete denture)

Participants	sex	age (y/o)	restored arch	Kennedy classification	Number of RPD implant abutments	implant diameter			splinting or not	Implant side	Number of nature tooth (restored arch)	follow up period (month)	opposing dentition
						Narrow <3.75	regular ≥3.75, <5	wide ≥5					
1	F	61	Mx	class IV	5	5	4	0	V	V	2	61	Nature teeth + implant
2	M	73	Mx	class IV	6	3	8	0	V	X	0	40	Nature teeth + implant
3	M	53	Mx	class IV	5	2	3	2	V	X	3	196	Nature teeth + implant
4	F	72	Mn	class I mod. 1	2	0	2	0	V	X	3	104	CD
5	M	84	Mx	class III mod. 1	2	0	0	2	V	V	8	118	Nature teeth
6	F	68	Mn	class I mod 1	3	2	1	0	V	V	3	37	CD
7	M	62	Mx	class IV	4	0	4	0	V	V	0	15	Nature teeth
8	F	77	Mn	class I mod. 1	2	2	0	0	X	X	0	36	Overdenture (nature teeth)
9	F	77	Mn	class I mod. 1	1	1	0	0	X	X	4	19	CD
10	F	75	Mn	class I mod. 1	2	0	2	0	X	X	0	40	Overdenture (nature teeth)
11	F	67	Mx	class I mod. 1	3	0	5	0	V	V	1	60	ISRPD
			Mn	class I mod. 1	2				V	V	4	60	ISRPD
12	F	93	Mn	class I mod. 1	2	2	0	0	V	V	2	60	CD
13	M	85	Mx	class IV	3	0	5	2	V	V	3	27	Nature teeth + implant
14	M	66	Mx	class IV	4	0	4	0	V	X	0	27	Implant
15	M	74	Mx	class I mod. 1	4	1	3	0	V	X	0	98	Overdenture (implant)
16	M	84	Mn	class IV	4	2	3	2	V	V	0	77	Nature teeth + implant

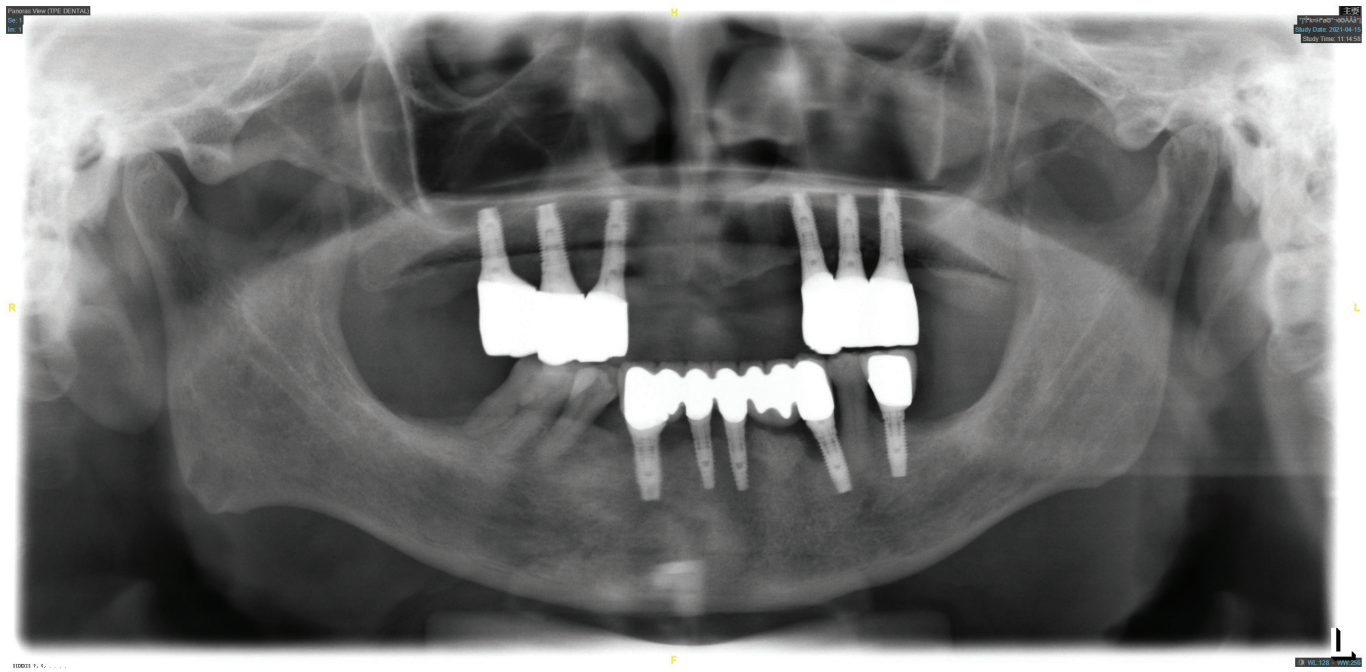

Figure 1. A Case of ICRPD

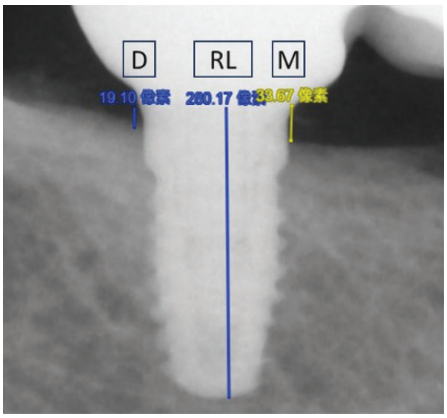

Figure 2.
Definition of MBL (marginal bone loss) around implants

- **M: measure distance from top to marginal bone contact level on radiograph (mesial)**
- **D: measure distance from top to marginal bone contact level on radiograph (distal)**
- **Average bone level (ABL)= $\frac{M+D}{2} \times \frac{AL}{RL}$**
- **AL: Actual length of place implant**
- **RL: Length of implants on radiograph**
- **Momentary rate of marginal bone loss=[(ABL at final visit)-(ABL at implant functional loading)]÷ follow years**

Table 2. Category, number of implants, marginal bone loss, statistical analysis, and power level

	category	number of implants	MBL	statistical	power
(1) Gender	M	45	0.058 ± 0.054	***P= 0.009**	0.5
	F	26	0.037 ± 0.031		
(2) Smoking	Y	11	0.021 ± 0.023	P= 0.022	0.6
	N	60	0.055 ±0.049		
(3) Location	Anterior	15	0.05 ± 0.043	P= 0.959	0.1
	posterior	56	0.05 ± 0.049		
(4) Restored arch	Mx	39	0.042 ± 0.04	P= 0.105	0.4
	Mn	32	0.061 ± 0.054		
(5) Opposing arch	Fixed	32	0.046 ± 0.043	P= 0.561	0.2
	Removable	16	0.046 ± 0.035		
	ISRPD	23	0.059 ± 0.061		
(6) Splinting or not	Y	63	0.049 ± 0.048	P= 0.182	0.2
	N	8	0.068 ± 0.036		
(7) As RPD abutment	Y	53	0.043 ± 0.042	P= 0.064	0.6
	N	18	0.071 ± 0.056		
(8) Implant diameter	Narrow	20	0.05 ± 0.038	P= 0.903	0.1
	Normal	43	0.051 ±0.052		
	wide	8	0.043 ± 0.05		
(9) Graft	Y	20	0.081 ± 0.056	***P< 0.001**	****0.096**
	N	51	0.038 ± 0.038		

***** Mean values of MBL showed significant difference based on independent t-test (< 0.05).
****** Post hoc power analysis showed clinically meaningful
(M: Male, F: Female, Y: Yes, N: No, Mx: Maxilla, Mn: Mandible, MBL: Marginal bone loss)

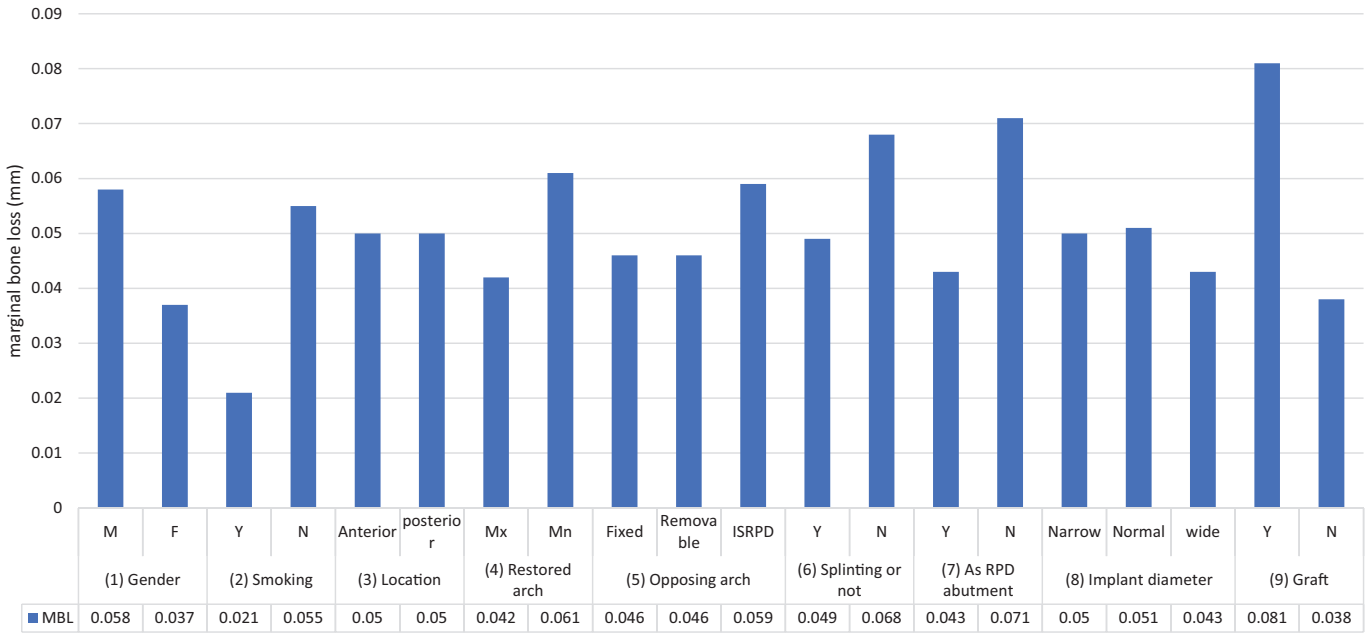

Figure 3. The average level of MBL for each of the main variables (M: male, F: female, Y: Yes, N: No, Mx: Maxilla, Mn: Mandible)

Results

ODuring the observation period, one of the 72 implants failed due to peri-implantitis after functional loading for 24 months. The 71 successful implants were analyzed in this study. The mean values and standard deviations of implant marginal bone resorption associated with different factors are shown in Table 2. Gender and MBL showed a significant association. The MBL of males (0.058 ± 0.054 mm in 45 implants) was significantly higher than that of females (0.037 ± 0.031 mm in 26 implants). No significant differences in MBL were observed for the following factors: whether or not smoking, restored arch, type of opposing arch, whether or not the implant crown was splinted, whether or not the implant was an RPD abutment, and implant diameter.

When implants were stratified by whether or not a bone graft was performed, a statistically significant relationship with MBL was observed. In this study, a bone graft meant guided bone regeneration, sinus lift, or both. A statistically significant result was obtained, which was shown to be clinically meaningful in the power analysis (power = 0.96). The average level of MBL for each category of the main independent variables is shown in Figure 3.

Discussion

Factors influencing marginal bone loss

The purpose of the present study was to evaluate the effects of gender, smoking, insertion side, type of opposing arch, crown splinting, implant as RPD abutment, implant diameter, and bone graft on marginal bone resorption around implants after functional loading. The reasons for MBL are still debated. The main hypotheses are infection and overloading.[18] However, it is clear that MBL is an important parameter of implant success.

Koller at el. classified the factors that influence the MBL of implants into three categories: (a) periodontal condition around implant, including plaque index, sulcus bleeding index, and probing pocket depth; (b) implant–prosthetic evaluation, including location, splinted or single crowns, cemented or screwed type, bone graft, and implant diameter, length, and type; and (c) occlusion design, including the size of occlusal platform, angle of cusps, static and dynamic movements, and region of the implants.[19] In addition to the three categories above, the patient's systemic factors (age, gender, and genetics) and social factors (socioeconomic status, oral hygiene, and stimulant consumption) may play an important role.[20,21]

All patients in the present study underwent reconstruction with IC-RPDs at least on one side. Most of the implant crowns used were RPD abutments. This study focused on implant prosthetic evaluation and the patient's systemic factors to determine effects on MBL. We did not consider the occlusal scheme because all the cases were planned as mutually protective occlusion or balancing occlusion according to the design of conventional removable dentures.

Gender and bone graft as factors affecting MBL

Most previous studies did not show a difference in MBL between males and females.[13,22–24] Some studies showed that the MBL of males was higher than that of females, but this difference was not statistically significant.[22–24] In contrast, other studies found that females had more MBL.[25,26] In this study, the MBL around implants was significantly higher in men than in women. According to Negri al el., MBL progressively increases with age in males, but reaches a peak in the 50–60 year age group in females.[23] The age distribution of females in this study's population was 61–93 years. Age was not included as a factor because most of the population in this study was older. In addition, 16 of the 45 implants in males involved a bone graft compared to only 4 of the 26 implants in females.

Bone graft was another factor in the study with a significant effect on MBL, a result with high power in the post-hoc analysis. MBL was higher in augmented bone not only during the implant functional loading period but also during the submerged implant healing stage.[27] However, most previous studies do not support a relationship between MBL and bone graft.[28–30] A three-year retrospective cohort study concluded that MBL mainly occurred during the first 12 months after functional loading, and was lower in subsequent years.[31] In early MBL, implants in sinus-grafted areas lose significantly less bone than those placed in pristine bone.[32] One of the reasons for this study's result is likely to be bone materials; in the cases of localized defects or insufficient bone height, synthetic substitute material (SinboneHT) and the implant were placed simultaneously. In contrast, in some of the studies discussed above, the xenogenic bone substitute was mixed with autogenous bone.

A cluster effect in marginal bone resorption meant that some patients show a tendency to several implants being affected in the mouth.[18] This effect was also seen in this study. Some patients with a higher number of implants with bone graft showed a higher MBL. This might be another reason for the higher MBL in the graft area.

Opposing arch as a factor affecting MBL

In this study, the opposing arch was classified as fixed, removable, or IC-RPD. These types did not differ significantly in their effect on implant MBL when one arch was restored with an IC-RPD. Some previous studies came to the same conclusion.[24,33] Yoo et al. differentiated dentition into five groups: natural teeth, implants, IODs, RPDs, and complete dentures (CDs). When the maxilla is restored with an IOD and the mandible is restored with implants, the maxilla shows a high level of MBL. In contrast, MBL is relatively low when both arches are reconstructed with implants.[13] Fixed dentures may lead to high occlusal force, resulting in greater MBL in the opposing arch. In eight cases in this study, the opposing dentition consisted of natural teeth or natural teeth combined with implants. Compared to IODs and CDs, IC-RPDs might be able to bear a higher occlusal force, thus resulting in less MBL.

Implant as RPD abutment as a factor affecting MBL

No significant difference in MBL was found between a normally fixed implant and the implant crown used as an RPD abutment. As previous studies tended to focus on implant overdentures, few considered IC-RPDs.[34, 35] In the present study, the use of the implant crown as an RPD abutment was feasible. In this study, most implants used as an RPD abutment were placed in the posterior area for better RPD support and chewing function. Most implants were splinted to resist the horizontal force of the RPD. No implant crown loosening after permanent cementation occurred. The chipping of the porcelain in two implant crowns was noted; there was no discomfort after the chipped area was rounded.

Smoking as a factor affecting MBL

There is evidence that smoking causes higher MBL.[36–38] In light smokers (< 10 cigarette/day), the correlation between the degree of smoking and the degree of MBL is positive.[39] However, the smoking dose was not recorded in this study. In a longitudinal study comparing individuals who had given up smoking for 10 years and those who smoked regularly, the progression in bone loss was significantly slower in the former.[40] The MBL of a patient in our study who had quit smoking for more than 30 years was lower than that of regular smokers.

Other factors affecting MBL

Implant location or restored arch did not have a significant effect on MBL, a result similar to those in previous studies.[13, 26] One study did not find

a difference in MBL, but the probing depth was greater in the maxilla,[33] while in another, MBL was greater in the maxilla, but no statistically significant effect of implant crown splinting in the maxilla was found.[41] In this study of only eight solitary implants (two in the maxilla and six in the mandible), the majority of the implants were splinted, which might have resulted in the lower MBL in the maxilla. However, most previous studies found that splinted or solitary implant crowns did not have a significant effect on MBL.[42,43] A proper prosthesis design is crucial. The splinted implant should be designed with a crown emergence angle of < 30° and a concave emergence profile on both the mesial and the distal side.[44] Even with a proper design, the middle implant of multiunit splinted implants has a high risk of peri-implant disease.[45] Therefore, the number of splinted implants should be considered.

In this study, most implants were splinted, of normal diameter, and in the posterior area.The IC-RPDs had a good clinical outcome, with high stability and retention and improved chewing effect compared to conventional RPDs. The limitations of this study include the small number of samples and the short follow-up period of some patients. In addition, not all factors affecting implant MBL were assessed, including bone type, bone quality, implant stability quotient, and the patient's oral hygiene. High disparity between samples might have led to outcome bias. Therefore, future studies on IC-RPDs should involve larger sample sizes and longer follow-up periods.

Conclusion

Based on the findings of this clinical study, the following conclusions may be drawn: (1) the use of implant crowns as RPD abutments is feasible; (2) implants in bone-grafted areas showed higher MBL than implants on pristine bone; and (3) males showed higher MBL than females.

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Case Report

Clinical considerations of implant overdentures using Locator-bar attachments: A clinical report

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Running title: Clinical considerations of Locator-bar attachments for implant overdentures

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Abstract

This clinical report explores the experience of Locator-bar attachments design in a maxillary implant overdenture. While conventional complete dentures exhibit limitations in masticatory function, implant-retained overdentures, particularly those featuring attachments, have gained prominence for their enhanced stability and retention. The report delves into the clinical procedure of reconstructing a mandibular overdenture with two Locator attachments, while the primary focus lies on the utilization of Locator-bar attachments in the maxillary implant overdenture. The Locator-bar attachment, often coupled with a metal bar connecting multiple implants, has demonstrated superior retention and stability compared to conventional Locator attachments.

The discussion underscores the broader landscape of implant overdenture attachments, comparing unsplinted and splinted types. Recent studies advocate for the combination of Locator attachments with computer-aided design and computer-aided manufacturing (CAD/CAM) milling bars, creating a Locator-bar attachment. The CAD/CAM milling bar offers accurate parallel path insertion, ensuring a precise fit. Moreover, it provides a cost-effective alternative to traditional casting methods.

Complications and maintenance considerations are also addressed, with Locator-bar attachments exhibiting less marginal bone resorption than their Locator implant counterparts. However, challenges in oral hygiene maintenance, particularly plaque and calculus deposition, are noted for splinted attachments. The report emphasizes the significance of routine prosthetic maintenance, highlighting the advantage of Locator-bar attachments in facilitating quicker retention device replacements with a lower likelihood of bar re-fabrication.

Key words: implant overdenture, Locator attachment, Locator-bar attachment

Introduction

Although conventional complete dentures remain a common treatment for edentulous patients, their limited efficacy in providing sufficient masticatory function often results in suboptimal treatment satisfaction. As progressive ridge resorption diminishes retention and stability over time, conventional dentures can lead to discomfort, pain, and a decline in overall oral function.[1] In the past decade, implant-retained overdentures have become the preferred choice for reconstructing masticatory function in both fully and partially edentulous patients.[2] The superiority of implant overdentures lies in their enhanced stability and retention, which address the shortcomings of conventional dentures and significantly improve masticatory function.[3] Recent reports consistently highlight the high success rates of single implants, which contribute to the overall effectiveness and stability of implant overdentures.[4]

To further augment the retention and stability of implant overdentures, various attachments, including bar-clip splinted attachments and individual attachments such as the Locator and magnet attachments, have been employed. Among these options, the Locator attachment stands out due to its versatility, reduced need for restoration space ,[5] lower costs, self-alignment for implant angulation correction, ease of component replacement, and compatibility between different implant manufacturers.

The applications of Locator attachments vary, ranging from a single Locator attachment directly connecting to a single implant to the Locator-bar attachment designed for multiple implants. The Locator-bar attachment, often coupled with a metal bar connecting more than four implants, significantly enhances retention and stability.[6] Notably, the simple thread formation of the Locator-bar attachment eliminates the need to re-fabricate a bar in cases where the metal female component loses retention due to abrasion. Compared to the Locator attachment, the Locator-bar attachment shows less marginal bone loss and requires less maintenance.

This clinical report details the treatment of a completely edentulous patient at the Department of Prosthodontics, Taipei Veterans General Hospital. While the mandibular overdenture was reconstructed using two Locator attachments, the focus of this report is the clinical procedure employing the Locator-bar attachment in the maxillary implant overdenture.

Case report

A 67-year-old male sought assistance for his maxillary hybrid denture and mandibular conventional complete denture after the private dental clinic he attended suddenly closed. The patient reported issues with a broken mandibular denture and persistent discomfort around the maxillary implants, particularly the posteriormost implant on the right side (Fig. 1). Upon examination, the existing maxillary prosthesis, a four-implant-retained hybrid denture, showed various misfits at each implant connection. Clinically, severe bone resorption on the buccal surface of the maxillary first premolar implant was observed, accompanied by deep probing depths and pus discharge (Fig. 2A–C). Simultaneously, the patient's existing mandibular prosthesis, a conventional complete denture, had catastrophically fractured across the anterior area, breaking in half.

The initial reconstruction involved fabricating a maxillary duplicate denture and a mandibular conventional interim denture (Fig. 3). Subsequent surgical preparations were carried out by the periodontists after the settling of upper and lower interim dentures. Bilateral mandibular canine implants (Biomet 3i, Palm Beach Gardens, FL, USA) were inserted at the same appointment. During the healing period of the lower arch, the previous maxillary first premolar implant was removed and then a new implant (Nobel Biocare, Kloten, Switzerland) was inserted after one and a half years (Fig. 4).

Both interim dentures underwent multiple adjustments during the healing period. Following implant osseointegration, two Locator attachments (Zest Anchors, Escondido, CA, USA) for the mandibular canine implants were delivered first.

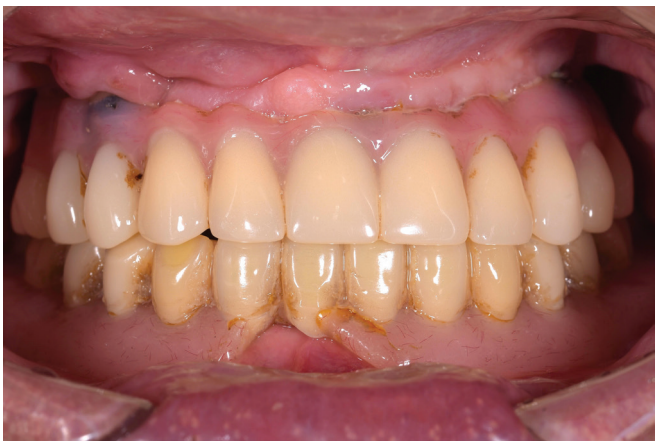
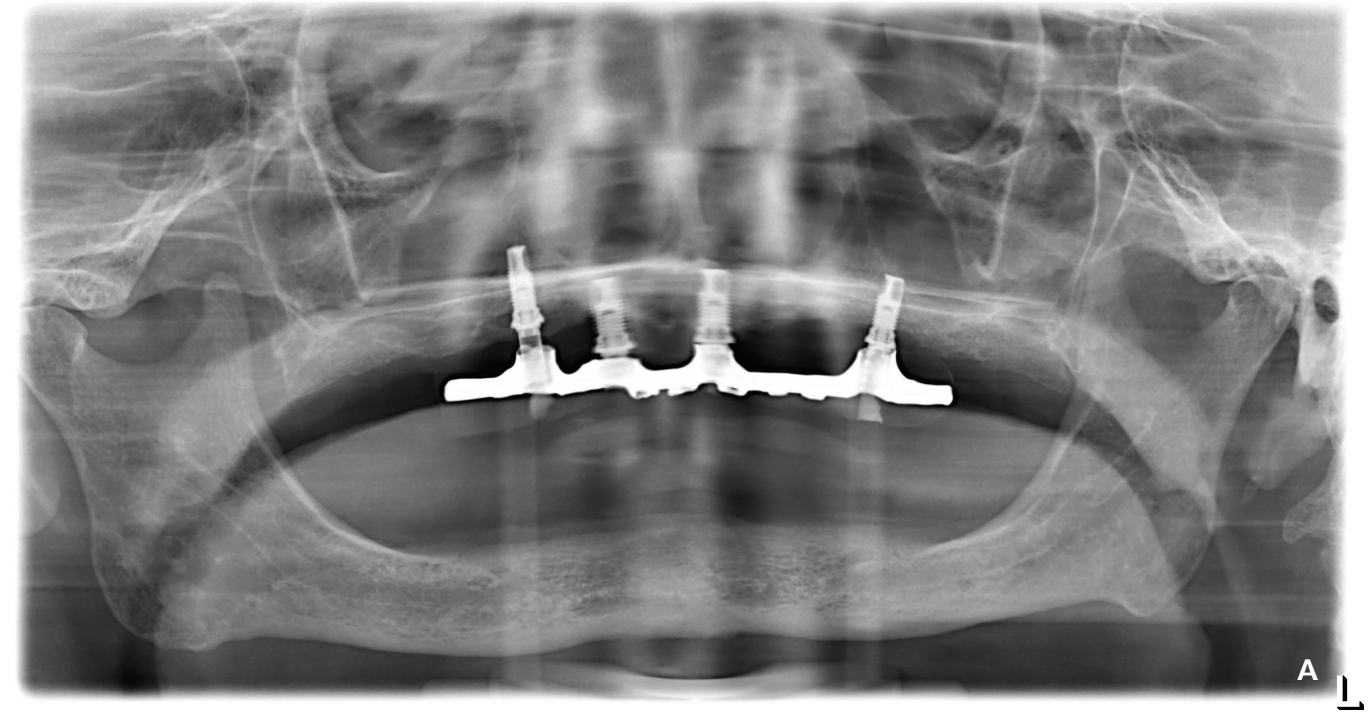
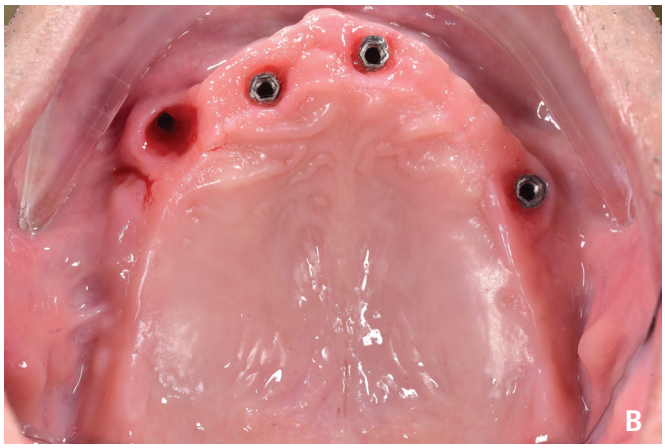


Figure 1.
Intraoral view of prior maxillary hybrid denture and fractured mandibular conventional complete denture.





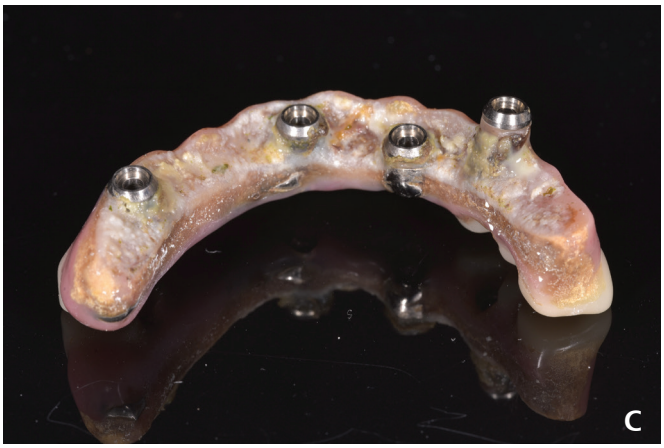


Figure 2. Clinical inspection of the maxillary arch.
(A) Panoramic film revealing various misfits on each implant.
(B) Severe gingival swelling observed around the maxillary right first premolar implant.
(C) Plaque and calculus deposition on the tissue surface of the maxillary hybrid denture.

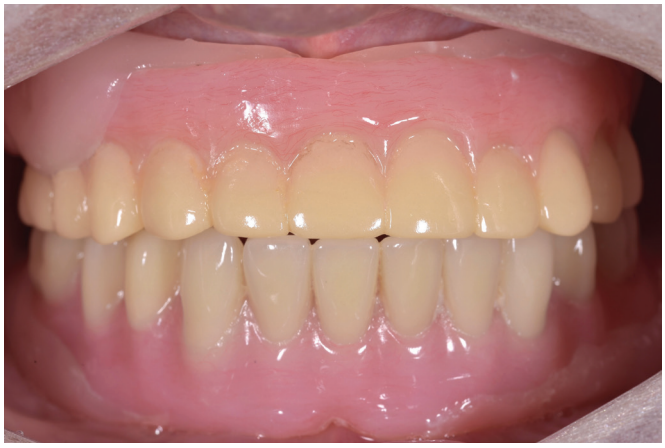


Figure 3. Preliminary reconstruction with interim dentures.

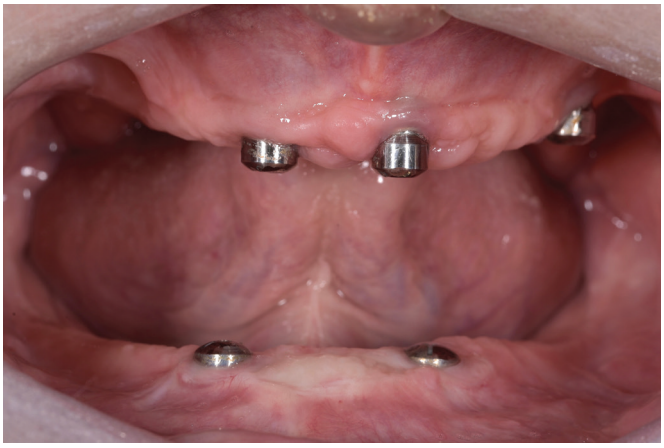


Figure 4. Intraoral view during the healing period after a new maxillary first premolar implant insertion.

The maxillary prosthetic procedures were more complex due to the splinting bar design. The closed tray impression technique was performed first with four separate impression copings. The open tray impression technique was next applied to maximize the accuracy of the definitive cast. Then, a verification jig, which mimicked the design of the definitive bar attachment, was fabricated from aluminum using the computer-aided design and computer-aided manufacturing (CAD/CAM) system. The one-screw test was performed chair-side with the verification jig to verify any misfit made during the laboratory steps (Fig. 5). As the accuracy of the definitive cast and the design of the attachment were confirmed, the definitive maxillary bar attachment was milled with two prefabricated blind threaded holes. Then, the maxillary Locator-bar attachment (Zest Anchors, Escondido, CA, USA) was installed in the mouth after the two Locator attachments were fixed into the threaded holes (Fig. 6A–C). The remaining steps of the procedure for fabricating definitive dentures followed the traditional denture fabrication process (Figs. 7 and 8).

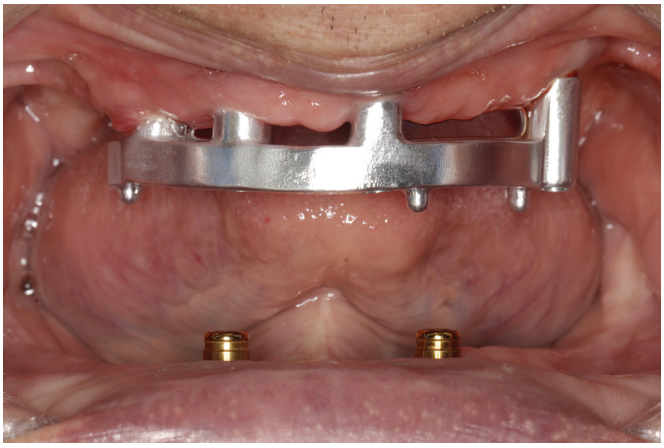


Figure 5. Intraoral view of maxillary verification jig, made of aluminum, used to verify the accuracy of the master model and the attachment design.

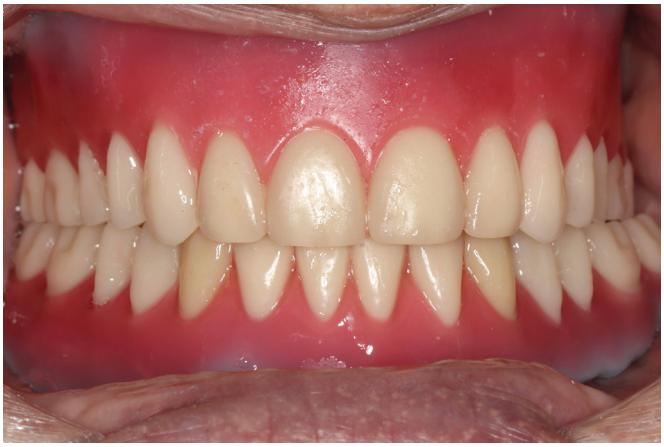


Figure 7. Intraoral view of the esthetic try-in.

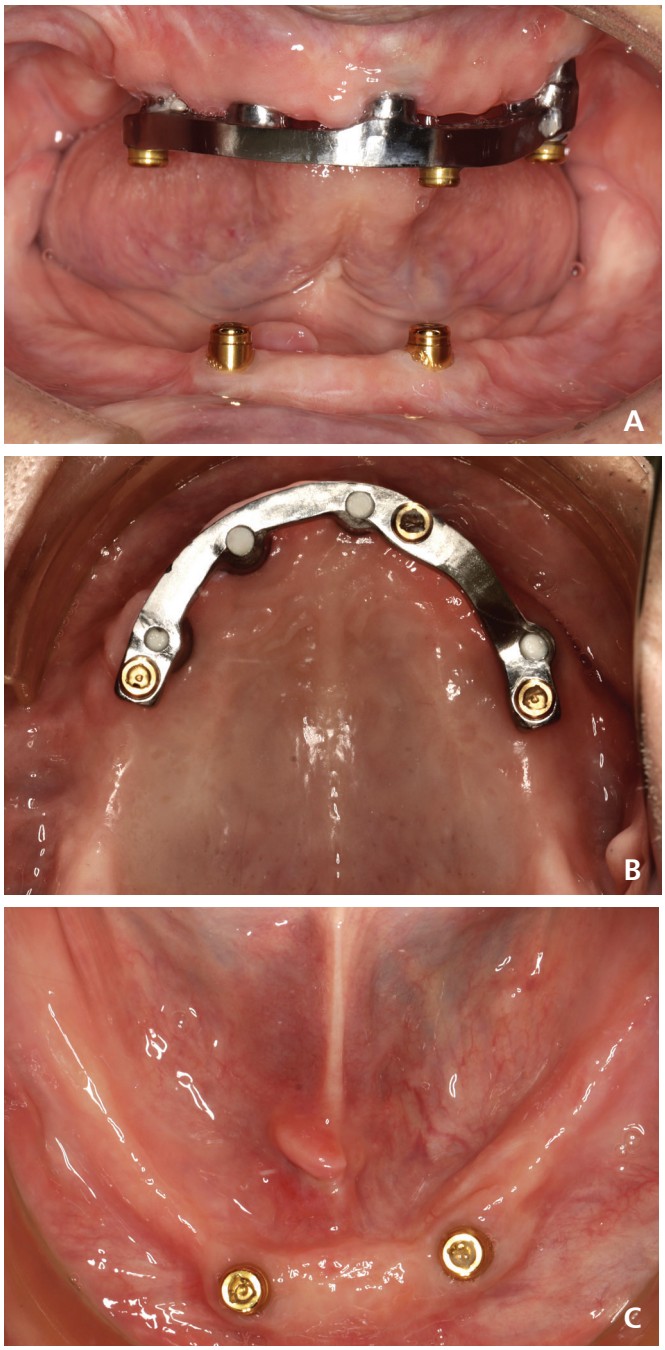


Figure 6.
(A) Intraoral view of implant attachments.
(B) The maxillary Locator-bar attachment used four implants that were splinted with a milling bar.
(C) The mandibular Locator implant attachments utilized two implants.

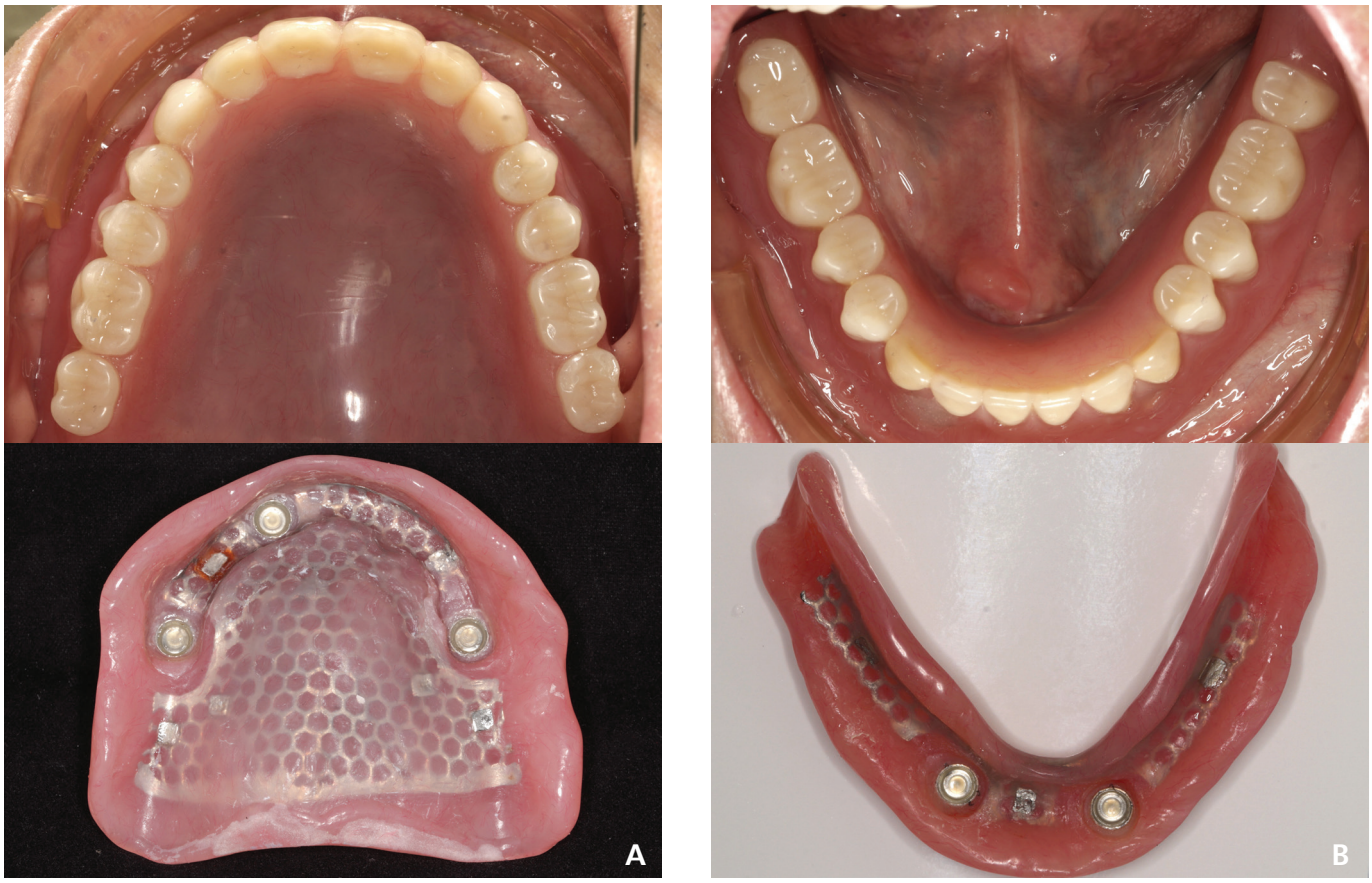


Figure 8. Delivery of the definitive prostheses.
(A) The maxillary implant overdenture.
(B) The mandibular implant overdenture.

Discussion

In contemporary dentistry, implant overdentures have emerged as the preferred choice over conventional complete dentures for edentulous patients. They offer not only improved masticatory function,[7] but also enhanced retention and stability,[8] and are particularly beneficial for individuals with compromised posterior bone quality or limited treatment budgets. The various attachments for implant overdentures can be broadly categorized as either splinted or unsplinted types.[9]

The unsplinted type, also known as a solitary attachment, can be installed with limited restoration space.[5] These attachments boast advantages such as lower cost, self-alignment for implant angulation, easy maintenance, and simple replacement.[10] However, they are weaker in horizontal stability than the splinted type of attachments, necessitating more frequent maintenance.[11] Conversely, in the splinted type attachments, or bar attachments, lateral stress is distributed through multiple implant insertions and rigid bar connections; consequently, these attachments offer superior retention and cross-arch stabilization but require more restoration space, typically at least 13–14 mm.[12]

Recent studies have explored the combination of Locator attachments and CAD/CAM milling bars, which creates a Locator-bar attachment. The CAD/CAM milling bar's key benefit is its accurate parallel path of insertion, which ensures precise adaptation to the denture base and reduces wear or retention loss due to excessive friction. While the fabrication of a precise casting bar involves a complex and technique-sensitive procedure, the CAD/CAM milling bar serves as a cost-effective alternative that easily achieves a passive connection fit without the complexities associated with casting. Moreover, a low-cost milling verification jig can be employed to confirm the master model's accuracy before manufacturing the definitive bar, thereby minimizing the risk of repeated fabrication or soldering.

In the case of complications, a clinical study has shown less marginal bone resorption with splinting with Locator-bar attachments compared to separate Locator implant attachments.[6] This may

be attributed to the rigid bar connection between implants, which effectively disperses stress. Conversely, maintenance of oral hygiene of splinted attachments, particularly Locator-bar attachments, poses greater challenges, with higher plaque and calculus deposition, compared to unsplinted attachments. Some studies have observed a higher number of lost implants with maxillary implant overdentures with four splinted implants than with dentures with separate implants.[13] However, a systematic review found no statistically significant difference in short-term survival rates of implants or overdentures between splinted and unsplinted implants.[13] Nonetheless, a 10-year follow-up study suggests a potential negative impact on long-term survival rates.[14]

Prosthesis maintenance is a noteworthy consideration for all types of implant overdenture attachments that require routine care post-insertion. Notably, Locator attachments often require replacement of the retention device, while the Locator-bar attachments have the advantage of quicker replacement and lower likelihood of refabrication of the bar.

In this clinical case, the patient expressed high satisfaction with the masticatory function, retention, and esthetics of the new implant overdentures following a four-month post-insertion period. Further observation is warranted, particularly of the maxillary Locator-bar attachment, to assess the long-term treatment outcomes.

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Case Report

Advancing oral rehabilitation: A case report on CAD/CAM obturator implementation for an oral cancer patient

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Abstract

Oral cancer treatment often leads to the loss of a portion of the maxilla or mandible, resulting in functional and aesthetic challenges for patients. Obturators made by Computer-Aided Design and Computer-Aided Manufacturing (CAD/CAM) have emerged as a revolutionary solution in dentistry. This case report presents the successful application of CAD/CAM obturator in restoring the form and function of the oral cavity for a 54-year-old patient who suffered from adenoid cystic carcinoma with limited mouth opening.

Key words: obturator, oral cancer, CAD/CAM, digital dentistry

Introduction

Oral cancer, a complex and debilitating condition, necessitates innovative approaches to address the functional and esthetic challenges posed by extensive surgical interventions such as maxillectomy. The treatment usually involves the use of a maxillary obturator, which blocks the oral nasal opening to re-establish speech and deglutition. Conventional obturator, while effective to some extent, often fall short in providing an optimal fit, comfort and functionality. The fabrication process encounters several complications; the risk of aspiration of impression material through oral nasal communication, difficulty placing the impression tray in patients with limited mouth opening, and problems when removing the impression from the oral cavity due to tissue scarring and undercuts around the defect.[1-5]

CAD/CAM technology is a revolutionary approach that combines computer-based design and manufacturing processes. It allows the creation of highly precise and customised dental prostheses, such as obturators, which are used to restore the form and function of the oral cavity. CAD/CAM technology utilised three-dimensional imaging, virtual modelling, and computer-controlled milling to fabricate prostheses that perfectly fit the patient's unique anatomy. [3,6]

CAD/CAM obturators offer several advantages over the traditional methods. The use of optical impression provides better patient comfort, reduce errors and risks when compared to conventional impression. Furthermore, CAD/CAM enables fewer hospital visits and faster fabrication times. This not only reduces the waiting time for patients but also allows immediate adjustments of modifications if necessary. CAD/CAM obturator

can be processed using biocompatible materials with better mechanical properties. The use of high-quality materials ensures longevity and minimised the risk of complications or discomfort for the patient.[7-10]

The implementation of CAD/CAM obturators has significantly improved the quality of life for oral cancer patients. By restoring the form and function of the oral cavity, these prostheses enable patients to speak, chew, and swallow more effectively. This restoration of basic oral functions not only inhales the patient's ability to communicate and eat but also improves their overall well-being and self-confidence.[2]

This case report delves into the successful application of a CAD/CAM obturator in the rehabilitation of a oral cancer patient. The rationale behind choosing CAD/CAM technology is explored in the context of its potential to offer personalised and precise solutions tailored to the unique anatomical and functional requirement of the patient.

Case Report

A 54-year-old female patient with previously failed implant assisted overdenture had been diagnosed with adenoid cystic carcinoma. Following tumour resection and total rhinectomy combined with a free flap reconstruction, the patient experienced significant functional and esthetic challenges (Fig. 1 to 3). A CAD/CAM obturator was designed and fabricated using digital imaging and virtual modelling techniques. The obturator restored the patient's ability to eat and drink effectively.

CAD/CAM procedure is as following:

1. Full mouth digital impression and occlusal record were made with an intraoral scanner (PrimeScan; Dentsply Sirona, Bensheim, Germany) (Fig. 4).
2. A standard tessellation language (STL) file of the maxilla was exported to CAD software (Exocad, Exocad GmbH, Darmstadt, Germany) for virtual modelling. Adjustments were made around the boundaries of the oral nasal communication (Fig. 5A to 5C).
3. Modified maxillary STL file was imported to CEREC InLab CAD software (InLAB SW 22.0, Dentsply-SironaTM, Bensheim, Germany). The outline of the obturator was designed on the modified maxillary model with minimal 4mm thickness (Fig. 5D and 5E). After final inspection of the design (Fig. 5F), CAD/CAM obturator with three open windows for implants was printed. (Fig. 5G to 5I).
4. The retention and the fitness of CAD/CAM obturator was checked with Fit Checker Advanced (GC, Japan) (Fig. 6A to 6C). The obturator was then relined with Durabase soft and polished (Fig. 6D to 6I).

Figure 1. Extraoral view. (A) Frontal. (B) Lateral.

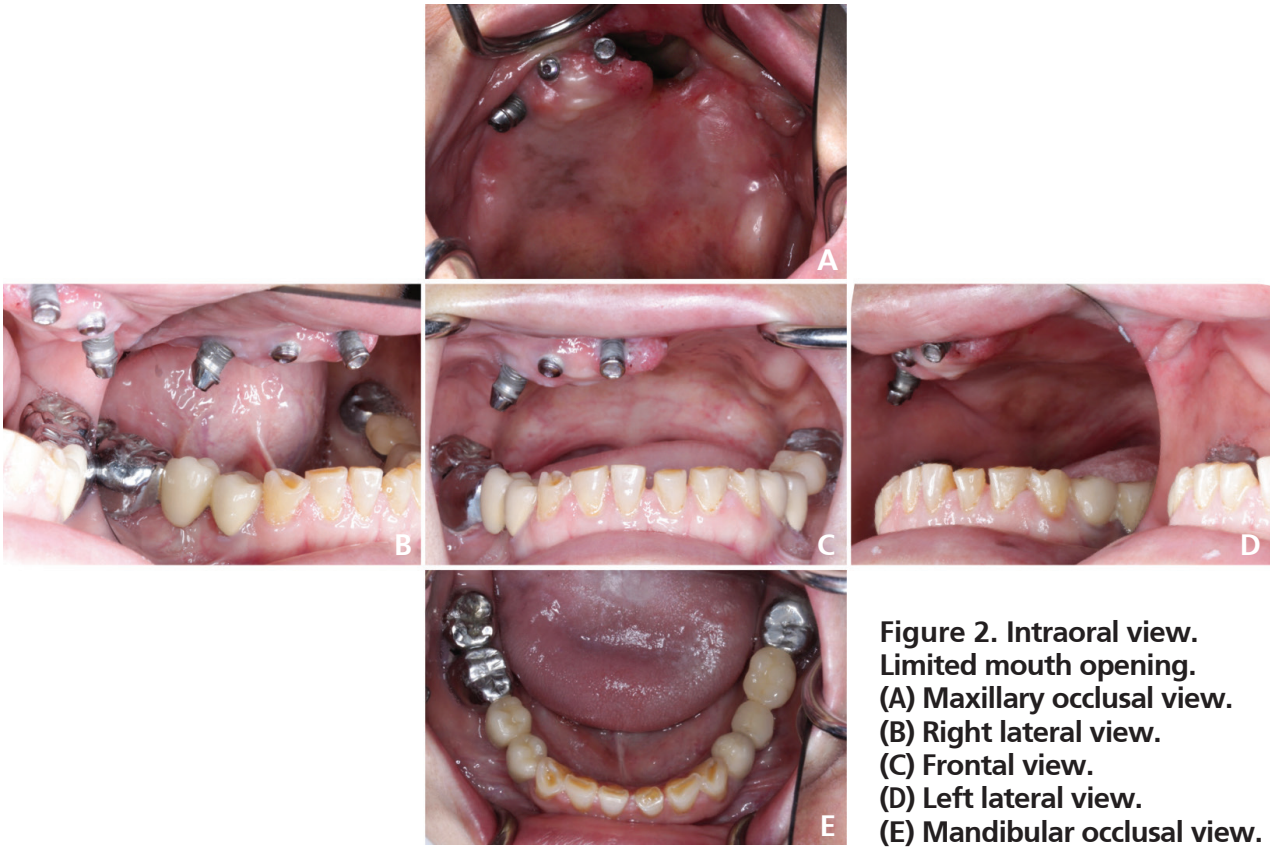

Figure 2. Intraoral view. Limited mouth opening. (A) Maxillary occlusal view. (B) Right lateral view. (C) Frontal view. (D) Left lateral view. (E) Mandibular occlusal view.

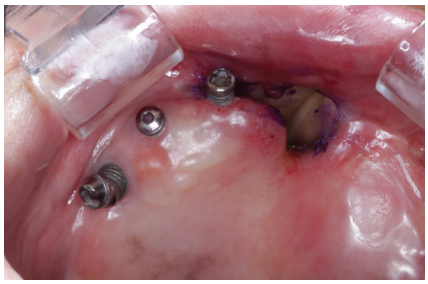

Figure 3. Use of dye to demarcate the boundary.

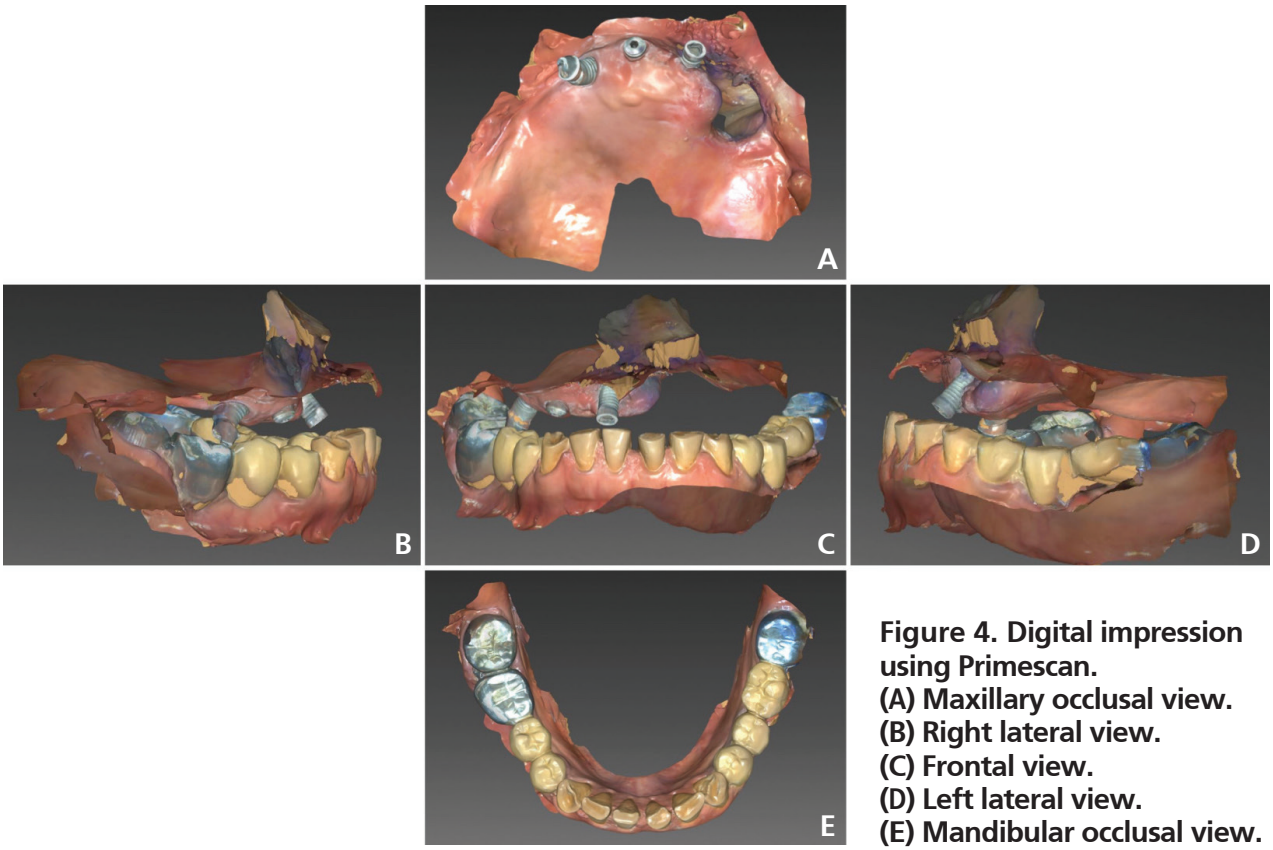

Figure 4. Digital impression using Primescan. (A) Maxillary occlusal view. (B) Right lateral view. (C) Frontal view. (D) Left lateral view. (E) Mandibular occlusal view.

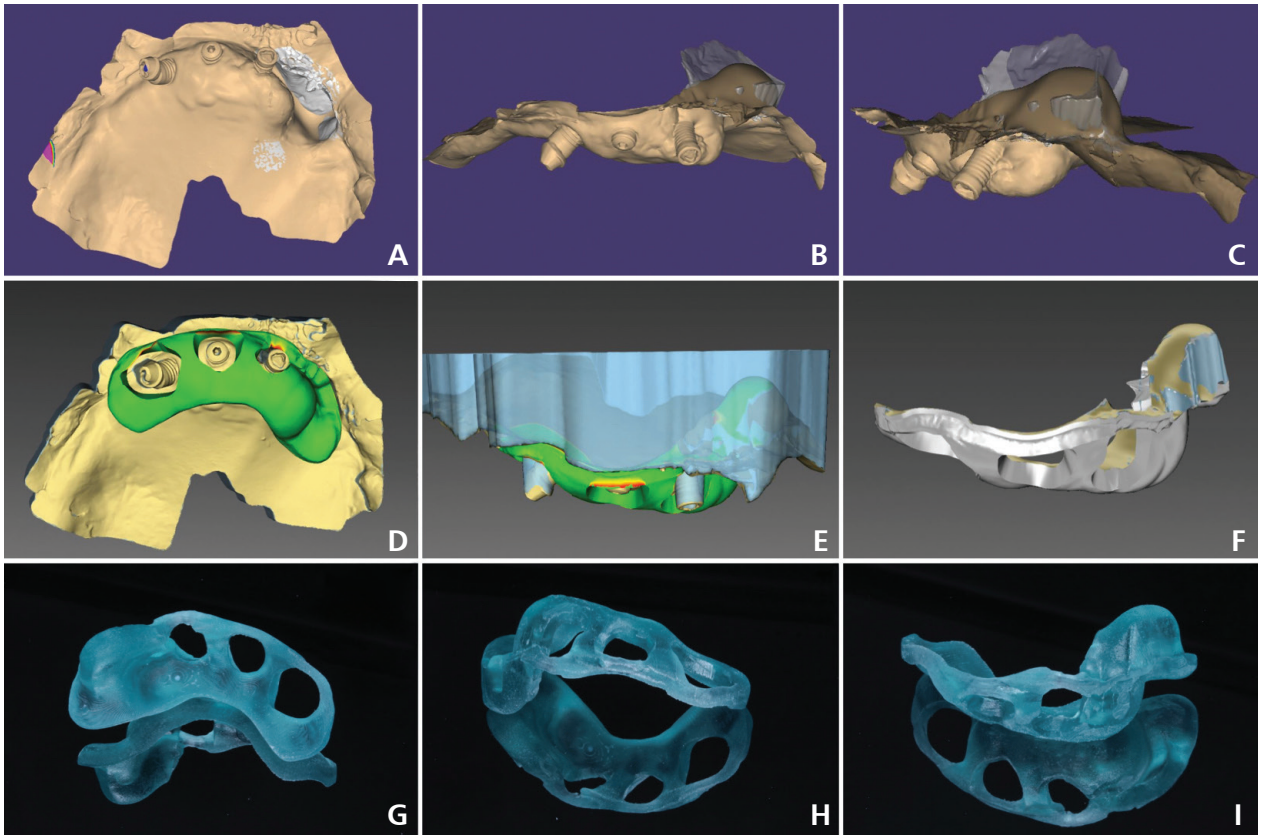

Figure 5. CAD/CAM process.
(A-C) Use of Exocad to adjust and smooth the defect. Yellow: original. Grey: adjusted.
(D-E) Design of obturator with minimal 4mm thickness.
(F) Final design before printing.
(G-I) Different views of printed obturator.

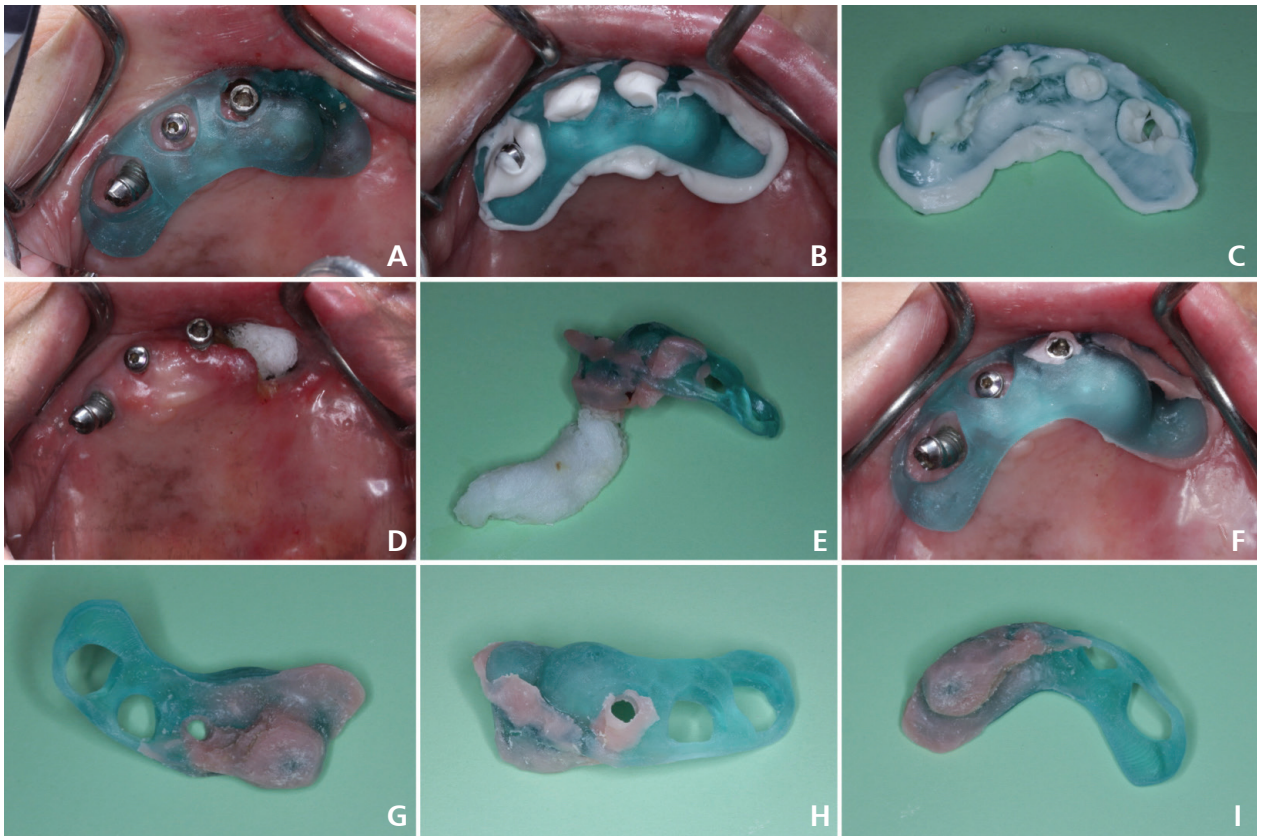

Figure 6. Intraoral adaptation.
(A) Clinical try in of obturator.
(B-C) Fitness checked using pressure indicating paste.
(D) Gauze placement inside the defect prior to relining.
(E) Relined obturator before polishing.
(F-I) Different views of relined obturator.

Discussion

The successful implementation of the CAD/CAM obturator in this case underscores its potential as a transformative tool in oral rehabilitation. The precision afforded by CAD/CAM technology in designing and fabricating patient-specific prosthetics represents a substantial leap forward from conventional methods.

Precision and personalization:

CAD/CAM technology allows for a meticulous and patient-specific design of obturators, addressing the unique anatomical intricacies of each individual. The use of advancing technology helps to overcome the limitations of soft tissue stitching while taking a digital impression; the implants presented in this case were used as references and helped to determine the ideal path of insertion. This offers high level of precision which is critical in optimising fit, comfort, and functionality.

Clinical efficacy:

The clinical outcomes observed in this case report demonstrate the superior efficacy of the CAD/CAM obturator in comparison to traditional methods. The improvements in speech, oral competence, and masticatory function contribute to a more comprehensive rehabilitation, positively impacting the patient's overall well-being.

Technological advancements and workflow efficiency:

The streamlined workflow of CAD/CAM technology, from digital imaging to virtual modelling and manufacturing, represents a notable advancement. This efficiency not only reduces fabrication time but also enhances the overall predictability and reproducibility of the prosthetic outcomes. Ogami et al. demonstrated the use of thermoplastic resin (PEKK) in denture production; the lightweight material offers patient an alternative as it reduces stress soft tissue [2]. This could be one of the material used for definitive prosthesis.

Patient satisfaction:

The subjective experience of the patient is paramount in evaluating the success of any prosthetic intervention. The increased comfort reported by the patient, coupled with improved functional outcomes, underscores the potential of CAD/CAM obturators to enhance patient satisfaction and quality of life.

Challenges and considerations:

While the success of this case is promising, it is essential to acknowledge potential challenges, including the cost of CAD/CAM technology implementation, the learning curve for clinicians, and the need for specialized equipment. Further research and long-term follow-up studies are warranted to validate these findings across diverse patient populations.

Conclusion

This case report provides compelling evidence for the transformative impact of CAD/CAM obturators in oral cancer rehabilitation post-maxillectomy. As the field of dental technology continues to evolve, the integration of precision-driven solutions such as CAD/CAM technology represents a paradigm shift in the approach to oral prosthetics. The implications of this case extend beyond the individual patient, offering valuable insights for clinicians, researchers, and the broader dental community as we collectively strive to enhance the quality of life for those affected by oral cancer.

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Journal of Prosthodontics and Implantology

Introduction for authors

Types of article

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

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

General Format guide

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

Review Articles Format Guide

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

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

Original Articles Format Guide

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

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

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

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

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

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

- Abstract: required, up to 400 words
- Keywords: up to 5
- Word limit: 3000 words
- References: up to 40

Technique Reports/ Case Reports Format Guide

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

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

Letters to the Editor Format Guide

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

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

Manuscript Preparation

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

The detailed specifications of the manuscript content are as follows:

➢ ***Title page***

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

➢ ***Abstract and keywords***

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

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

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

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

➢ ***Main Text***

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

(2) **Original article:** The text for original articles should be organized into the following sections: introduction, materials and methods, results, discussion, and conclusion.

- 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.

➢ ***Figures and legends***

- Illustrations should not be included in the main text or edited, but should be stored in a separate folder. Image files should be archived in JPG, EPS or TIF format and submitted electronically via e-mail.
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- The patient's facial photo must cover the eyes to the extent that the person cannot be identified, otherwise the patient's written consent must be attached.
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- The number of figures should be restricted to the minimum necessary to support the textual material. Figures should have an informative figure legend and be numbered in the order of their citation in the text.
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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***

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

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- A short letter to the Editor-in-Chief.
- The detailed information of the corresponding author (name and address in Chinese and English, telephone and fax numbers, email address). The names of all authors and their affiliations.
- An abstract in English (no longer than 400 words) containing the study purpose, materials and methods, results, and main conclusion.
- 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.
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一、凡與基礎或臨床補綴學、顳顎關節或咀嚼功能、人工植體相關、牙科補綴之技工學有關之著作，均為刊載之對象。接受的稿件類型共有下列五種，來稿請註明類型：

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2. 研究論文（original artic1e）
3. 技術報告（technical report）
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1. 首頁（title page）：包括題目、作者姓名、服務單位、學歷；英文簡題（running title）長度在四十個字元（character）以內；稿件主要負責者（corresponding author）之英文姓名與地址、電話、傳真、e-mail。
2. 英文摘要（abstract）：以 400 字為限，簡潔說明研究目的、方法、結果、主要結論或新發現。並需附關鍵詞（key words）5 個以內。
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文章應旨在為讀者提供關於補綴學領域一個重要且具時效性議題的平衡概述。內容應涵蓋已達成科學共識的主題及仍具爭議性且是持續科學研究的議題。所有文章或數據來源應以系統性方式選取納入評論範圍，並進行嚴格的評估。

- 摘要：必需，最多400 字，無需結構（即無子標題）
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(2) 原始著作（original article）

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標題頁應包含以下資訊（從頁面頂部至底部，依次排列）：

◆ 文章類別

◆ 文章標題

◆ 所有作者的全名及其所屬機構；作者的名字後方應加上小寫字母的上標，對應置於機構名稱前的相同上標。

◆ 通訊作者資訊，包括姓名、電子郵件、通訊地址、電話號碼和傳真號碼。

◆ 不超過40 個字元的簡短標題（running title）

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必須有摘要（不超過400 字）及關鍵字（限5 個以內）。

◆ 綜述文章、病例報告與技術報告的摘要應無結構（即單段無分節標題），並包括報告的背景/目的、方法、結果（或病例報告）及結論。

◆ 原創性文章的摘要: 應分為以下部分：

- 目的：簡要說明研究主題的重要性，並準確陳述研究問題或目的。
- 材料與方法：簡要介紹研究使用的方法，包括研究設計、場域、研究對象、介入措施、結果測量及分析方法（如適用）。
- 結果：簡要呈現重要結果，包括數據及統計細節（如p 值等）；確保摘要中的資訊與正文一致。
- 結論：陳述研究發現的意義，注意直接回應研究問題，並將結論限制在摘要涵蓋的範圍內；正面與負面結果應給予相同重視。
- 關鍵字應選自《醫學主題詞表》（Medical Subject Headings,MeSH）列表（網址：http://www.nlm.nih.gov/mesh/meshhome.html）。

■ 內文一分前言、材料與方法、結果、討論、結論。

◆ 前言（Introduction）：簡要說明研究由來。

◆ 材料與方法（Material and Methods）：敘述研究設計、對象、步驟。

◆ 結果（Results）：研究結果以文字、表格或插圖表示之。

◆ 討論（Discussion）：強調重要結果與論點，與前人論述作比較等。

◆ 結論（Conclusion）：結論要簡要明確。

(3) 技術報告（technical report）－分前言、方法、討論。

(4) 病例報告（case report）－分前言、病例、討論。

這類文章為對具有獨特特徵的病例/病例系列/技術報告的簡短討論，這些特徵尚未被描述過，但具有重要的教學意義或科學觀察價值。文章可以描述新穎的技術或設備的使用，或關於重要疾病的新資訊。段落標題應包括：摘要、前言、病例報告、討論、利益衝突聲明（如有）、致謝（如有）以及參考文獻。病例報告作者應不超過6 位，文章總長不得超過2000 字，參考文獻數量不得超過10 個。

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例如：

(1) 期刊之書寫：

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.

(2) 書籍之書寫：

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

(3) 有編輯者之書籍章節書寫：

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

(4) 電子期刊之書寫：

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

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(2) 插圖之標題及詳細說明，須另頁複行繕打。顯微照像須以比例尺（internalscale marker）標明放大倍數。

(3) 病人臉部照片須遮蓋眼睛至無法辨認是何人的程度，否則須附病人之書面同意書。

(4) 繪圖軟體應使用如 Photoshop、Photoimpact、Illustrator 等。彩色或灰階圖形須掃描至 300 DPI，線條圖形則須至 1200 DPI，並請標明圖檔名稱及所使用軟硬體名稱。

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如需反覆提及某術語/定義，首次出現時必須完整拼寫，並在後方括號內附上縮寫。隨後可直接使用縮寫。縮寫不應首次出現在章節標題中；如果縮寫已在正文中定義過，則可在後續章節標題中使用該縮寫。請將縮寫數量限制在必要範圍內，並確保全篇文章中縮寫使用一致。若定義的縮寫並未在後文出現（不包括圖表中），則應刪除該縮寫。

8. 數字

以數字開頭的句子或小於10 的數字應以文字形式拼寫。世紀和年代應拼寫出來，例如：Eighties（80 年代）或 nineteenth century（19 世紀）。實驗參數、時間、溫度、長度、面積、質量和體積應以數字表示。

9. 單位

必須使用國際單位制（SI）單位，惟血壓值應以mm Hg 為單位。長度、面積、質量和體積請使用公制單位表示。溫度應以攝氏度表示。

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對於藥物，除非討論中特別需要提及藥品的專有商品名，否則應使用推薦的國際非專利藥名（rINN）。通用藥物名稱應在正文中以小寫字母表示。若需標明特定的專有藥品，則僅在正文中首次提及該藥物時，在通用名稱後的括號中標明其商品名稱。

11. 對於設備及其他產品，首次提及時應提供具體品牌或商標名稱、製造商及其所在地（城市、省/州及國家），例如：「SPSS version 11 was used (SPSS Inc.,Chicago, IL, USA)」。隨後如適用，應使用通用名稱。

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- 附英文摘要（400 字以內），研究論文的摘要應分研究目的、材料與方法、結果、結論。
- 附英文關鍵詞（5 個以內）；附英文簡題（長度在 40 個字元以內）。
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- 確認所有表格（標題、註腳）及插圖之標題及詳細說明，另頁複行繕打。
- 確認所有圖表皆符合格式。圖表皆儲存於另外的檔案夾，而非放置於本文中。
- 若為人體(動物)試驗須附人體(動物)試驗委員會之同意函。
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