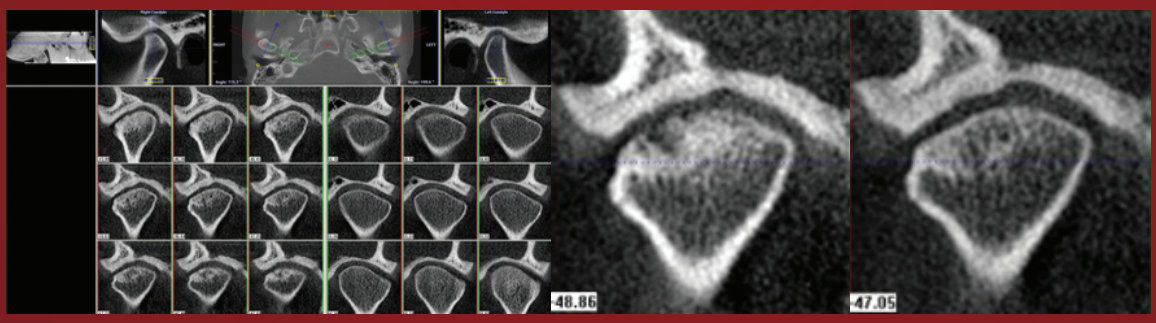
The Academy of Prosthetic Dentistry R.O.C., Taiwan

Journal of Prosthodontics and Implantology



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Journal of Prosthodontics and Implantology

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Journal of Prosthodontics and Implantology

Editorial

Editorial: Staying Abreast of the Latest Advancements in Prosthetic Dentistry

A satellite meeting of the International College of Prosthodontists was recently held from August 30 to September 2 in London, where numerous advanced research and clinical reports were presented at the conference. To provide the best possible care to our patients, it is crucial for professionals to stay abreast of the latest advancements and research in the ever-evolving field of prosthetic dentistry. Dental professionals can achieve this by participating in international conferences and reading journals dedicated to prosthetic dentistry. The Journal of Prosthodontics and Implantology recognizes the immense value it brings to the field and the professionals who serve it.

The journal fosters an environment where knowledge-sharing and networking opportunities abound. The diverse range of perspectives and experiences presented in the journal can lead to innovative breakthroughs and enhanced treatment methodologies. Through the journal, we can gain valuable insights into the latest materials, techniques, technologies, and research. Thus, attending international conferences and reading journals in prosthetic dentistry are excellent ways for professionals to invest in their development.

In conclusion, the value of international conferences and journals in prosthetic dentistry cannot be overstated. They facilitate knowledge exchange, networking, exposure to cutting-edge research, professional development, and a global perspective that ultimately benefits both dental professionals and, most importantly, the patients they serve. As the Journal of Prosthodontics and Implantology, we encourage all dental professionals to actively participate in these conferences and our journal to stay at the forefront of their field and continue providing the highest quality of care.

Li-Deh Lin, Editor-in-Chief

Original Article

Gingiva retraction width -How narrow can intraoral scan detect? A pilot study

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Abstract

Purpose: *This study aimed to determine the minimum appropriate gingival retraction width acceptable for digital oral scans and for developing the emergence profile.*

Materials and methods: *These analyses used the upper right first molar of a dental typodont model. A 0.5-mm chamfer margin was formed along the typodont tooth's cementoenamel junction. Pink acrylic material was used to simulate the gums at the mesial and distal ends of the typodont tooth mounted on a digital vernier caliper. The widths of the simulated gingival retraction were divided into seven groups: 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, and 0.7 mm. Two digital oral scanners, the Primescan (Dentsply Sirona) and 3Shape Trios 3 (3Shape), were used to scan each simulated gingival retraction model five times, and the obtained 3D model was output into STL files. A 3D engineering software (Geomagic control X) was used to superimpose and align the 3D images within each group for each digital oral scanner. The original model angle was evaluated using non-parental analysis and one-way analysis of variance (ANOVA). A clinically acceptable angle deviation was defined as 10°, which served as the standard to judge whether the data could be used to estimate the emergence profile.*

Results:

3Shape group:

The average angles in the groups with simulated gingival retraction widths of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, and 0.7 mm were 58.8° ± 6.1°, 160.7° ± 3.9°, 155.3° ± 2.4°, 154.0° ± 2.6°, 155.4° ± 3.0°, 154.0° ± 1.5°, and 153.4° ± 2.6°, respectively.

The groups with gingival retraction widths of 0.3, 0.4, 0.5, 0.6, and 0.7 mm showed acceptable results within ±10° of the true shape angle.

Primescan group:

The average angles in the groups with simulated gingival retraction widths of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, and 0.7 mm were 58.8° ± 6.1°, 160.7° ± 3.9°, 155.3° ± 2.4°, 154.0° ± 2.6°, 155.4° ± 3.0°, 154.0° ± 1.5°, and 153.4° ± 2.6°, respectively.

The groups with gingival retraction widths of 0.2, 0.3, 0.4, 0.5, 0.6, and 0.7 mm showed acceptable results within ±10° of the true shape angle.

Conclusions: *Under this experiment's conditions, we recommend that the gingival retraction width be ≥0.3 mm for the 3Shape system and ≥0.2 mm for the Primescan system.*

Key words: fixed prosthodontics; full crown; tooth preparation; intraoral optical scanning (IOS); digital dentistry

Introduction

A good impression should capture the fine details and accuracy of the finish line structure of the abutment teeth to ensure a good prosthesis fit. Clinically useful results can be obtained after proper gingival retraction with traditional impressions. However, digital impressions are now widely used in clinical practice, and studies have confirmed that as long as good-quality digital impressions are available, clinically acceptable accuracy prostheses can be fabricated.[1-6]

However, under actual clinical conditions, partial or complete removal of the retraction cord is followed by a rapid recovery of the gums, leaving an impression time of <30 s.[7] Moreover, obtaining a digital impression of the gingival edge remains difficult. Some studies have noted that the finish line of the scanning abutment tooth near the gum is easily deformed. When the finish lines of the abutment teeth and the gingival margin are too close, the digital oral scan often connects the gums with the adjacent finish lines of the abutment teeth, reducing scan accuracy.[8,9] Nevertheless, no previous study has evaluated the influence of the gingival retraction width on the accuracy of the scan finish line when using digital oral scans.

Digital impressions are known to be most easily deformed near the gingiva. Unfortunately, there are no recommended gingival retraction widths to avoid deformation of the finish line. This study aimed to test and determine the optimal gingival retraction width to obtain good-quality digital impressions in oral scans.

Material & methods

The analyses used the upper right first molar of a dental typodont model. To form a 0.5-mm chamfer margin along the typodont tooth's cementoenamel junction (CEJ), the height of the abutment teeth was approximately 6 mm. The angle between the tangent of the chamfer margin and the tangent of the root surface was approximately 150° (Fig. 1). Hygenic Repair Acrylic (Coltene Whaledent) was used to simulate gums at the typodont tooth's mesial end, and Ceramage Gum (SHOFU Dental) was used to simulate gums at the typodont tooth's distal end. The simulated gingiva's mesial and distal ends were fixed on the two lower jaws of the digital Vernier caliper. When the two lower jaws were opened, the simulated gingiva's mesial end separated from the typodont tooth. The amount of separation was the width of the simulated gingival retraction, which could be determined from the reading of the digital Vernier caliper (Figs. 2).

The width of the simulated gingival retraction

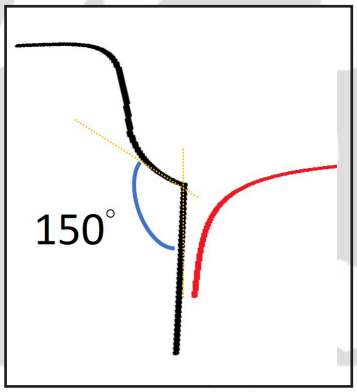

Figure 1. The angle between the tangents of the chamfer margin and the root surface was approximately 150°.

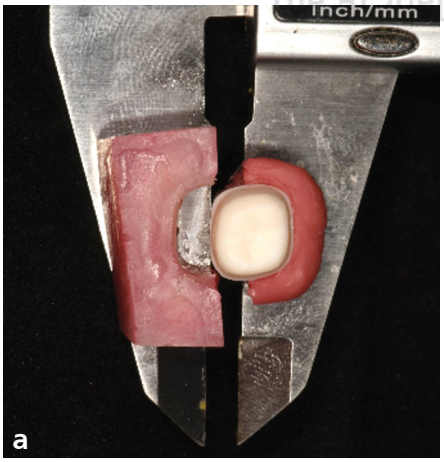

Figure 2a. When the two lower jaws were opened, the mesial end of the simulated gingiva separated from the typodont tooth.

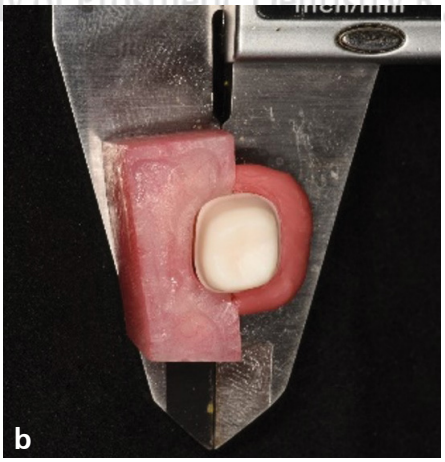

Figure 2b. The amount of separation was the width of the simulated gingival retraction.

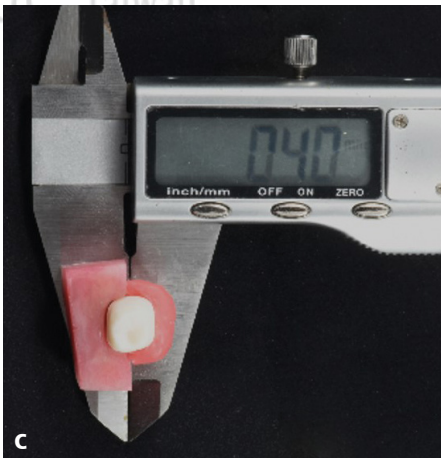

Figure 2c. The amount of separation could be determined from the reading on the digital vernier caliper.

was divided into seven groups: 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, and 0.7 mm. Two digital oral scanners were used after calibration: Primescan (Dentsply Sirona, Bensheim, Germany) and Trios 3 (3Shape, Copenhagen, Denmark). Each digital oral scanner creates five models for each group of simulated gingival retraction and outputs the obtained 3D models into STL files (Figs. 3).

3D engineering software (Geomagic Control X, 2017) was used to superimpose and align the 3D images within each group as follows: (1) The angle between the abutment tooth's edge slope and its root was measured on the same longitudinal section (Fig. 3; the AB connection was the longitudinal section parallel to the tooth's long axis), and the scanning result and the original model angle were compared using non-parental analysis and one-way analysis of variance. (2) By defining a clinically acceptable angle deviation of 10° as the standard to judge whether the data could be used to estimate the emergence profile, the findings were categorized as follows: (i) The finish line and the emergence profile were indistinguishable (Fig. 4a); (ii) the finish line was distinguishable, but the emergence profile was not distinguishable (Fig. 4b); (iii) The finish line and the emergence profile were both distinguishable (Fig. 4c).

Results

3Shape

Table 1 shows the average angles with simulated gingival retraction widths. The angle obtained with a simulated gingival retraction width of 0.1 mm differed significantly from those obtained with the other simulated gingival retraction widths ($P = 0.0122$). In addition, the angle obtained with a simulated gingival retraction width of 0.2 mm differed significantly from those obtained with simulated gingival retraction widths of 0.3, 0.4, 0.5, 0.6, and 0.7 mm ($P < 0.05$).

We could clearly distinguish the finish line and the emergence profile when the simulated gingival retraction width was ≥0.3 mm (Tables 2 and 3).

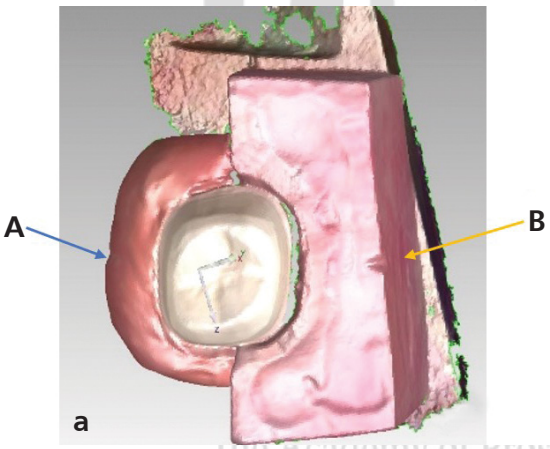

Figure 3a. Measurement points A and B.

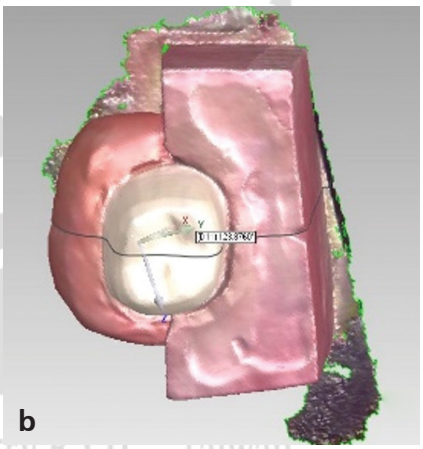

Figure 3b. The AB connection shows the longitudinal section parallel to the long axis of the tooth.

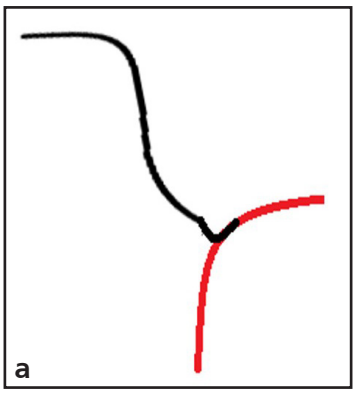

Figure 4a. The finish line and emergence profile were not distinguishable.

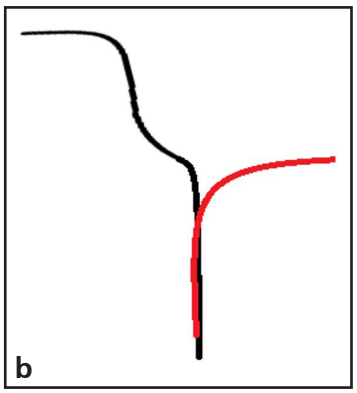

Figure 4b. The finish line was distinguishable, but the emergence profile was not distinguishable.

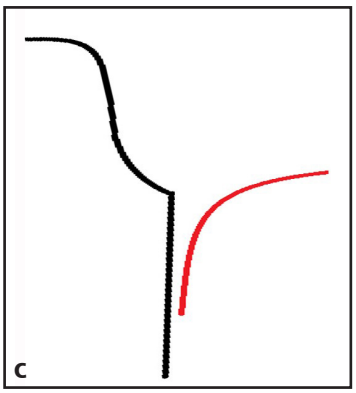

Figure 4c. The finish line and emergence profile were both distinguishable.

The groups with gingival retraction widths of 0.3, 0.4, 0.5, 0.6, and 0.7 mm showed acceptable results within ±10° of the true shape angle. The differences between the angles obtained with each group and the actual angles are shown in Table 4.

Primescan

Table 1 shows the average angles with simulated gingival retraction widths. The angle obtained with a simulated gingival retraction width of 0.1 mm differed significantly from those obtained with the other simulated gingival retraction widths ($P < 0.05$). In addition, the angle obtained with a simulated gingival retraction width of 0.3 mm differed significantly from those obtained with simulated gingival retraction widths of 0.5, 0.6, and 0.7 mm ($P < 0.05$).

We could clearly distinguish the finish line and the emergence profile when the simulated gingival retraction width was ≥0.2 mm (Tables 2 and 3).

The groups with gingival retraction widths of 0.2, 0.3, 0.4, 0.5, 0.6, and 0.7 mm showed acceptable results within ±10° of the true shape angle. The differences between the angles obtained with each group and the actual angles are shown in Table 4.

In the same case, when the width of the simulated gingival retraction was 0.2 mm, the angle difference was noticeably larger in the 3Shape group than in the Primescan group.

Discussion

Under the experimental conditions, when the gingival distance was 0.1 mm, the performance of both oral scanners was poor, and the finish line and emergence profile could not be distinguished. In the Primescan groups, the finish line and emergence profile could be clearly distinguished when the simulated gingival retraction was ≥0.2 mm. In contrast, in the 3Shape groups, the finish line and emergence profile could be clearly distinguished when the simulated gingival retraction was ≥0.3 mm. Primescan also showed poor scanning results in the 0.3-mm group, potentially due to the error caused by tangent sampling. While the different oral scanners have different limitations, the original manufacturer may not provide relevant test data.

This study was the first to discuss the differences in the emergence profiles obtained from digital oral scans with gingival retraction. Du et al. reported that the emergence angles of the upper anterior teeth CEJ are 11.30° to 15.26°.[10] When the error is >10°, the oral scan data used to evaluate the emergence profile lose relevance. Therefore, in this experiment, a threshold difference of ±10° between the angles obtained using the scans and the real angle was defined to determine the suitability of the measured values regarding the emergence profile.

A review by Sa et al. stated that traditional impressions with polyvinylsiloxane require a gingival sulcus with a width of about 0.15~0.2 mm to avoid tearing and deformation of the impression material and obtain a clear finish line.[11] A greater gingival retraction width is necessary if technicians can distinguish the emergence profile.

Many factors can affect the accuracy of the finish line of the abutment teeth obtained from oral scans, including the position of the finish line. When the finish line of the abutment teeth is close to the gingiva, adequate retraction is recommended to allow the oral scanner to obtain sufficient digital images to generate a clear finish line. Our experimental design simply compared the scanning limits of two oral scanners under different gingival retraction widths in vitro. It did not account for the limiting interference of various factors encountered during clinical scanning, such as intraoral moisture; scanning methods; lip, cheek, and tongue interference; and adjacent teeth interference. In addition, the optical properties of artificial resin teeth and real teeth differ, and further experiments are needed to confirm whether these differences affect the scanning results.

In addition, this experiment only compared the findings obtained with even gingiva, and the effects of different gingival heights will be compared in a series of subsequent studies. Keeling et al. reported that the experimental buccal side margin design was originally equivalent.[8] When the margin was elevated by 1 mm supragingivally, the curvature of the margin increased (the margin became sharper). Mounting the model on a manikin head did not affect this result. The margin sharpness was lower for all scans taken with adjacent teeth in situ. The presence of adjacent teeth affects the ability of the scanner to directly view all aspects of the dentition.[8] Our experiment focused on the width of gingival retraction, so the adjacent teeth were removed to reduce their impact. Our results were similar to those obtained by Keeling et al., and further data analysis was conducted.

An evaluation of previous oral scan-related

Table 1. Average angles with simulated gingival retraction widths.

Width of the simulated gingival retraction	0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm	0.6 mm	0.7 mm
3Shape	58.8 ± 6.1	160.7 ± 3.9	155.3 ± 2.4	154.0 ± 2.6	155.4 ± 3.0	154.0 ± 1.5	153.4 ± 2.6
Primescan	57.8 ± 1.2	150.5 ± 3.7	154.4 ± 2.7	150.2 ± 1.7	149.0 ± 1.9	148.0 ± 1.2	148.3 ± 1.0

Table 2. Distinguishing the finish line in the scan data.
In the 3Shape groups, we could clearly distinguish the finish line when the simulated gingival retraction width was ≥0.3 mm. In the Primescan groups, the finish line could be clearly distinguished when the simulated gingival retraction width was ≥0.2 mm.

Finish line	0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm	0.6 mm	0.7 mm
3Shape	X	X	O	O	O	O	O
Primescan	X	O	O	O	O	O	O

Table 3. Distinguishing the emergence profile in the scan data.
In the 3Shape groups, we could clearly distinguish the emergence profile when the simulated gingival retraction was ≥0.3 mm. In the Primescan groups, we could clearly distinguish the emergence profile when the simulated gingival retraction width was ≥0.2 mm.

Emergence Profile	0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm	0.6 mm	0.7 mm
3Shape	X	X	O	O	O	O	O
Primescan	X	O	O	O	O	O	O

Table 4. Differences between the angles measured with the scanner and the real angles in each group.

Width of the simulated gingival retraction	0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm	0.6 mm	0.7 mm
3Shape	-91.2 ± 6.1	+10.7 ± 3.9	+5.3 ± 2.4	+4.0 ± 2.6	+5.4 ± 3.0	+4.0 ± 1.5	+3.4 ± 2.6
Primescan	-92.2 ± 1.2	+0.5 ± 3.7	+4.4 ± 2.7	+0.2 ± 1.7	-1.0 ± 1.9	-2.0 ± 1.2	-1.7 ± 1.0

research showed no comparison of the effects of different gingival retraction widths. Therefore, similar studies are rare. The number of samples in this experiment was small, and evaluations with each simulated gingival retraction were repeated with each oral scanner five times. However, the trend identified in this study could be evaluated in future studies with more samples. Moreover, this experiment compared only two oral scanners. In the future, more research is needed to compare different oral scanners and the effects of adjacent teeth, intraoral environment simulation, and the finish line under the gums on the oral scan results.

The results obtained with the 3Shape and Primescan scanners differed in this study, potentially reflecting differences in their image formation principles. 3Shape uses confocal laser scanning microscopy, capturing multiple two-dimensional images at different depths in a sample to reconstruct three-dimensional structures (a process known as optical sectioning) within an object. In contrast, Primescan is based on a new surface acquisition technology: dynamic depth scan and high-frequency contrast analysis. This technique yields a higher image resolution and improves the accuracy of the consolidation. Based on the characteristics of the tooth surface, the wavelength of the scanning light source was adjusted to the blue-violet wavelength with the highest reflectivity. This optimization could reduce the error level caused by its penetration into different materials and improve the optical resolution in the depth of the field.

This experiment did not directly compare the two oral scanners. In the future, more research is needed to directly compare the accuracy of different digital oral scanners.

Conclusions

The digital impression of the digital oral scanner must show good gingival retraction to obtain an accurate model. This experiment's results suggest that acquiring digital impressions using the oral scanner requires a stricter set of conditions than the traditional impression method in cases with gingival retraction. The finish line and the emergence profile could be clearly distinguished in the Primescan and 3Shape groups when the simulated gingival retraction was ≥0.2 and ≥0.3 mm, respectively. The accuracy of Primescan with simulated gingival retraction ≥0.2 mm and 3Shape Trios with simulated gingival retraction ≥0.3 mm was very good. Similar tests must be performed before clinical operations to obtain good clinical results if other mouth scanners are used.

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Original Article

Analysis of proximal contact loss between implant-supported fixed dental prostheses and adjacent natural teeth: A two-year prospective study

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Running title: Contact loss between implant & adjacent teeth

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Abstract

Aims: *This prospective study aimed to evaluate the incidence of interproximal contact loss (ICL) between implant-supported fixed dental prostheses (FDPs) and adjacent teeth and to analyze the possible causative factors of this phenomenon.*

Materials and methods: *Patients in need of maxillary or mandibular posterior implant-supported partial FDPs (≤3 units) or single crowns (SCs) were recruited. All patients were followed up with clinical and radiographical examinations at 6, 12, and 24 months after delivery of the definitive implant restorations. The condition of interproximal contacts between implant-supported FDPs and adjacent mesial natural teeth were evaluated during the follow-up period. Prosthesis materials, implant positions, retained type, the condition of the mesial natural tooth, orthodontic treatment history, bruxism habit, and wearing conditions of the dentition were also assessed.*

Results: *Twenty-seven patients with 68 implant-supported FDPs (62 SCs and 6 partial FDPs) were enrolled in this study. One participant dropped out because the adjacent mesial tooth was extracted due to a fracture before the 24-month follow-up. The overall mesial ICL rate was 13.2%, 23.5%, and 37.3% at 6-, 12-, and 24-month follow-up, respectively. Age ($p = .002$), orthodontic treatment history ($p = .010$), condition of the mesial natural tooth ($p = .016$), and obvious wear facets of natural dentition ($p = .047$) were significantly associated with the presence of ICL at 24-month follow-up.*

Conclusions: *This study found that the longer the follow-up period was the higher the prevalence of mesial ICL. Furthermore, older age, patients not wearing an orthodontic retainer, a mesial tooth with crown or partial FDP, and severely worn dentition contributed to the mesial ICL of implant-supported FDPs.*

Key words: Implant-supported fixed dental prosthesis, proximal contact loss

Introduction

Implant therapy, which was introduced more than three decades ago, has been shown to have high survival and success rates. The reported survival rate of implant-supported single crowns (SCs) 10 years after loading is 95.2%.[1] However, complications associated with implant-supported fixed dental prostheses (FDPs), such as abutment screw loosening or fracture, restorative material chipping,[1] and mesial interproximal contact loss (ICL),[2,3] have been reported. Among these complications, the development of open contact between implant-supported FDPs and the adjacent teeth has been underestimated.

Several systematic reviews have reported that 34–66% of implant-supported FDPs next to natural teeth develop ICL after a short period.[2,4,5] Wei et al. observed ICL between implant-supported FDPs and adjacent teeth in more than 50% of the patients examined.[6] Byun et al. reported that only 46% of the proximal contacts examined were still tight after a mean follow-up period of 57 months and the risk of ICL increased 9.4% annually during the follow-up period.[7] A retrospective study of 4325 implants reported an overall ICL rate of 17%, which increased over time and reached 29% at eight years after insertion.[3]

The physiology of lifelong craniofacial growth and physiological differences between teeth and implants are likely to be the cause of ICL between implant-supported FDPs and adjacent teeth. Implants are ankylosed in the bone,[8] whereas natural teeth are suspended by the periodontal ligament, which allows a certain amount of movement over the life span of the individual.[9] Therefore, osseointegrated implants maintain their internal relationship with the bone under significant changes due to craniofacial growth and migration of adjacent teeth.

Clinical studies investigating ICL between implant-supported FDPs and natural teeth have proposed that the rate of ICL along the mesial aspect of the implant-supported FDPs was significantly higher than that along the distal aspect. Previous studies have suggested that contact loss along the mesial aspect can be explained by mesial migration of the adjacent natural teeth.[6,10,11] Factors such as gender, aging, vitality of adjacent teeth, type of opposing dentition, location of implant prostheses, strength of occlusal force, and splinting of adjacent teeth have been proposed as factors likely to be associated with ICL, but these relationships remain unclear.[6,7,10,11,12,13] Most studies investigating ICL showed higher incidences of contact loss on the mesial side rather than on the distal side.[6,10-14] Therefore, the purpose of this prospective study was to investigate the prevalence and potential contributing factors of ICL between implant-supported FDPs and adjacent mesial teeth. We tested the null hypothesis that there was no significant difference between implant-supported FDPs and adjacent teeth in developing ICL.

Materials and methods

Subject selection

Patients in need of maxillary or mandibular posterior implant-supported SCs or partial FDPs were recruited at the Department of Dentistry of Chi Mei Medical Center. The participants were selected according to the following inclusion criteria: age ≥18 years; needed implant-supported SCs or partial FDPs in the maxillary and mandibular premolar and molar area; and full-mouth plaque scores and full-mouth bleeding scores of <25%. Patients were excluded from the study for the following reasons: their oral hygiene was inadequate; they had serious systemic disease; they had uncontrolled metabolic diseases; they had uncontrolled periodontal diseases or uncontrolled progressive dental diseases, such as dental decay, apical periodontitis, and secondary occlusal trauma; or they were in need of more than four units of implant-supported FDPs.

The participants provided written informed consent prior to inclusion in the study. The Institutional Review Board of the Chi Mei Medical Center, Taiwan approved the study protocol (application number: 10105-L02).

Surgical and prosthetic procedures

All surgical and prosthetic procedures were performed by experienced clinicians according to the manufacturer's instructions. Two implant systems, Straumann (Standard or Standard Plus Implants; Straumann, Basel, Switzerland) and Nobel Biocare implants (Mark III Implants, Nobel Biocare, Gothenburg, Sweden), were used in this study. After osseointegration, either metal–ceramic or zirconia-based partial FDPs or SCs were made and inserted at 35 Ncm of torque . All prostheses had opposing natural dentition or tooth- or implant-supported FDPs.

Clinical assessments

All patients were followed up with clinical and radiographic examinations at 6, 12, and 24 months after delivery of the implant-supported SCs and partial FDPs. Waxed dental floss (Essential floss, Oral-B Laboratories Inc., Redwood City, CA, USA) was used to access the interproximal contact between the implant-supported FDP and adjacent teeth.[15] A tight contact was one that had resistance with a "click" sound when passing through the interproximal contact area. In contrast, an open contact was one with neither resistance force nor a "click" sound, or had a distinct gap between the prosthesis and adjacent teeth. Apart from the condition of mesial contact, the following parameters were also assessed during the follow-up period: age, gender, the material used for the prostheses, implant position, the type of prosthesis retention, the type of prosthesis (SC or 3-unit partial FDP), history of orthodontic treatment, the restorative condition of the adjacent teeth, the presence of bruxism, and dentition with or without obvious wear facets.

Data analyses

Descriptive statistics were used to summarize the data. The rate of prevalence of mesial ICL and the associated parameters were compared and analyzed with Fisher's exact test. The level of significance was set as $p < .05$.

Results

Based on the inclusion and exclusion criteria, 27 patients between 30 and 68 years of age (mean age 50.88 years) with a total of 68 implant-supported FDPs (38 in males and 30 in females; 62 SCs and 6 partial FDPs) were enrolled in this study (Table 1). The overall mesial contact loss rate was 13.2%, 23.5%, and 37.3% at 6-, 12-, and 24-month follow-up, respectively. One participant dropped out because the adjacent mesial tooth was extracted due to a fracture before the 24-month follow-up (Table 2). There were no statistically significant differences in mesial ICL and all parameters at the 6- and 12-month follow-ups ($p > .05$). However, the parameters age (p = .002), orthodontic treatment history ($p = .010$), condition of the mesial natural tooth ($p = .016$), and obvious wear facets of natural dentition ($p = .047$) were significantly associated with the presence of ICL at the 24-month follow-up (Table 3). Therefore, the null hypothesis was rejected. Other parameters including gender, the prosthesis material, implant position, retained type, prosthesis type, and bruxism were not related to ICL at the 24-month visit.

Table 1. Description of the study sample.

Gender	**Male**		**Female**
	38 (55.9%)		30 (44.1%)
Prosthesis material	Porcelain fused to metal		All ceramic
	19 (27.9%)		49 (72.1%)
Implant position	Premolar		Molar
	20 (29.4%)		48 (70.6%)
Retention	Screw-retained		Cement-retained
	16 (23.5%)		52 (76.5%)
Prosthesis type	Crown		FDP
	62 (91.2%)		6 (8.8%)
Orthodontic treatment history	No		Yes
	58 (85.3%)		10 (14.7%)
Condition of the adjacent mesial teeth	Virgin	Crown	FDP
	39 (57.4%)	26 (38.2%)	3 (4.4%)
Bruxism	No		Yes
	50 (73.5%)		18 (26.5%)
Obvious wear facet	No		Yes
	35 (51.5%)		33 (48.5%)

FDP, fixed dental prosthesis

Table 2. Rate of mesial contact loss at 6-, 12-, and 24-month follow-up.

	6 months	12 months	24 months (valid percentage)
No contact loss	59 (86.8%)	52 (76.5%)	42 (62.7%)
Loss of proximal contact	9 (13.2%)	16 (23.5%)	25,(37.3%)
Total	68 (100%)	68 (100%)	67 (100%)

Table 3. Characteristics of patient groups.

		6 months		12 months		24 months	
		Intact contact	Contact loss	Intact contact	Contact loss	Intact contact	Contact loss
Age, years	Mean	50.90	50.78	50.38	52.50	47.79	55.88
	SD	10.263	12.686	10.685	10.066	11.308	6.772
	p-value	0.975		0.485		0.002*	
Gender	Male	33 (86.8%)	5 (13.2%)	29 (76.3%)	9 (23.7%)	23 (62.2%)	14 (37.8%)
	Female	26 (86.7%)	4 (13.3%)	23 (76.7%)	7 (23.3%)	19 (63.3%)	11 (36.7%)
	p-value	1.000		1.000		1.000	
The material of prosthesis	PFM	15 (78.9%)	4 (21.1%)	14 (73.7%)	5 (26.3%)	12 (63.2%)	7 (36.8%)
	Zirconia	44 (89.8%)	5 (10.2%)	38 (77.6%)	11 (22.4%)	30 (62.5%)	18 (37.5%)
	p-value	0.253		0.757		1.000	
Implant position	Premolar	17 (85.0%)	3 (15.0%)	15 (75.0%)	5 (25.0%)	12 (60.0%)	8 (40.0%)
	Molar	42 (87.5%)	6 (12.5%)	37 (77.1%)	11 (22.9%)	30 (63.8%)	17 (36.2%)
	p-value	1.000		1.000		0.788	
Retainer type	Crown	53 (85.5%)	9 (14.5%)	46 (74.2%)	16 (25.8%)	39 (63.9%)	22 (36.1%)
	Partial FDP	6 (100.0%)	0 (0.0%)	6 (100.0%)	0 (0.0%)	3 (50.0%)	3 (50.0%)
	p-value	1.000		0.323		0.664	
History of orthodontic treatment	No	51 (89.5%)	6 (10.5%)	43 (75.4%)	14 (24.6%)	31 (55.4%)	25 (45.6%)
	Yes	7 (70.0%)	3 (30.0%)	8 (80.0%)	2 (20.0%)	10 (100.0%)	0 (0.0%)
	p-value	0.250		1.000		0.010*	
Condition of mesial natural tooth	Virgin	34 (87.5%)	5 (12.8%)	33 (84.6%)	6 (15.4%)	30 (76.9%)	9 (23.1%)
	Crown	22 (84.6%)	4 (15.4%)	17 (65.4%)	9 (34.6%)	11 (44.0%)	14 (56.0%)
	FDP	3 (100.0%)	0 (0.0%)	2 (66.7%)	1 (33.3%)	1 (33.3%)	2 (66.7%)
	p-value	0.753		0.185		0.016*	
Bruxism	No	42 (84.0%)	8 (16.0%)	37 (74.0%)	13 (26.0%)	31 (63.3%)	18 (36.7%)
	Yes	17 (94.4%)	1 (5.6%)	15 (83.3%)	3 (16.7%)	11 (61.1%)	7 (38.9%)
	p-value	0.427		0.529		1.000	
Obvious wear facet	No	30 (83.3%)	6 (16.7%)	29 (80.6%)	7 (19.4%)	26 (74.3%)	9 (25.7%)
	Yes	29 (90.6%)	3 (9.4%)	23 (71.9%)	9 (28.1%)	16 (50.0%)	16 (50.0%)
	p-value	0.484		0.568		0.047*	

FDP, fixed dental prosthesis; **PFM**, porcelain fused to metal; **SD**, standard deviation.
*p < .05.

Discussion

Interproximal contact loss between implant-supported FDPs and adjacent natural teeth is a common multifactorial implant complication reported in the literature.[2–4,6,7,10–13] However, its frequency and etiology are not well understood and are determined mostly based on clinical judgment rather than evidence.

In this study, the incidence of ICL increased over time from 13.2% at 6-month follow-up to 23.5% and 37.3% at 12- and 24-month follow-up, respectively. In previous studies, ICL rates varied between 24.3% and 59.9%.[4,6,10,11,15,16] This discrepancy might be because of differences in evaluation methods, study populations, monitoring period, prosthesis design, and statistical methods.[4,10–13,17] In other studies as well as this investigation, the interproximal contacts between implant-supported FDPs and natural teeth were assessed with the aid of waxed dental floss. This method can be considered user-dependent, which may also explain the differences in incidence rates between studies.

The present study also investigated the associated factors potentially influencing ICL. Age was positively correlated with the ICL rate at the 24-month follow-up, a result similar to those of previous studies showing higher ICL between implant-supported FDPs and adjacent teeth in older patients.[10,12,15] This might be due to increased tooth mobility in older subjects, which is positively correlated with age and the Periotest value.[12]

Pang et al. suggested that higher occlusal force displaces natural teeth mesially and causes the more frequent loss of interproximal contact.[15] The present study showed that in patients with severely worn dentition, which indicated higher occlusal force, implant-supported FDPs had a significantly higher rate of mesial contact loss after 24 months of clinical service. Wei et al.[6] suggested that high occlusal force on the adjacent tooth might enhance mesial migration. On mandibular closure, the anterior component of occlusal force drives the tooth mesially. According to an anthropological view of tooth wear, direct relationships exist between occlusal load and interproximal wear and mesial migration of teeth.[18] Occlusal load from mastication of hard food causes obvious occlusal and interproximal wear and is responsible for the movement of adjacent teeth, leading to interproximal wear.

Interproximal contact of an implant-supported FDP adjacent to SCs or other FDPs also leads to a high prevalence of contact loss compared to the virgin tooth. In the meta-analysis by Ng et al.,[19] teeth restored with a crown had a 3.92 times higher chance of survival than teeth without a crown after root canal treatment. Many mesial natural teeth restored with FDPs in this study had received endodontic treatment. Previous studies reported that there is a tendency for non-vital teeth to have a higher ICL rate.[7,10] An implant-supported restoration adjacent to a composite resin restoration showed higher ICL compared to restorations adjacent to unrestored teeth, metal restorations, or ceramic restorations.[20] Composite resin restoration could explain this lower wear resistance and failure to remain in tight contact over time.[21,22] Therefore, in this study, the higher ICL rate of the mesial natural teeth restored with SCs or FDPs may be due to previous endodontic treatment and the different wearing effects of the different restorative materials.

The patients who received orthodontic treatment also had a lower ICL rate at 24 month follow-up. Normally, after achieving proper alignment and occlusion, the surrounding periodontium takes around a year to reorganize and adapt itself.[23] Retainers, defined as orthodontic appliances, are used to prevent the return of dentition to their pre-treatment positions after orthodontic treatment. In addition, they also maintain teeth in their positions instead of driving them mesially. In the present study, the lower prevalence of ICL among patients with a history of orthodontic treatment may be explained by the use of orthodontic retainers. Therefore, some previous studies recommend the regular use of vacuum-formed retainers to prevent ICL.[2,24]

The present study has some limitations, including the small sample size and relatively short observation time. Furthermore, dental floss was used as an easy and simple method to assess interproximal contact.[25,26] However, the assessment of proximal contact with the aid of dental floss was subjective. Adjustment of the proximal surfaces of implant-supported restorations until two shim stock sheets can pass through the contact area has been recommended.[27] Hence, further studies with larger sample sizes, longer follow-up periods, and more objective assessment methods are needed to elucidate the prevalence and contributing factors of ICL.

Conclusions

Despite the limitations of this prospective study, the following conclusions could be drawn:

1. The incidence of ICL appeared to increase over time, with the rate rising from 13.2% at 6-month follow-up to 23.5% and 37.3% at 12- and 24-month follow-up, respectively.
2. Implant-supported restorations in older age, not wearing an orthodontic retainer, a mesial tooth restored with a crown or partial FDP, and severely worn dentition were the various factors contributing to mesial ICL of implant-supported FDPs at 24-month follow-up.

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Case Report

Clinical benefits of angled screw channel implant prosthesis in the esthetic zone: A case report

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Abstract

Compared to cement-retained implant crowns, screw-retained restorations offer the advantages of retrievability and reduced risk of peri-implantitis related to residual cement. The angulation of the conventional screw should follow the long-axis of the implant. In cases of implant malposition or unfavorable angulation, screw access may compromise functional and esthetic outcomes, especially in the anterior maxillary area. The angled screw channel design allows the screw access angulation to diverge up to 28 degrees from the implant axis. This case report discusses the use of the angled screw channel system to correct a labially tilted implant placement in the anterior maxilla.

Key words: angled screw channel, screw-retained prosthesis, esthetic

Introduction

The implant prosthesis is a successful treatment option that meets the esthetic and functional requirements of dentistry patients. The restoration can be connected to the implant by cement or screw. The advantages of cement-retained implant prostheses include the feasibility of correcting unfavorable implant position, passive fit, and easier control of occlusion.[1] However, mucositis and peri-implantitis related to residual cement are major complications of cement-retained implant prostheses.[2] Moreover, difficulties in subgingival removal and retrieval of excess cement make the screw-retained prosthesis a better choice.[3,4] Conventionally, the angulation of the screw has to coincide with the long-axis of the implant. However, the bony structure of the anterior maxilla hinders the ideal positioning of the implant because it does not allow a screw-retained restoration.

In 2004, the angled screw channel (ASC) abutment design (Dynamic Abutment; Talladium International Implantology) was introduced allowing divergence of the screw access angulation from the implant axis. The hexalobular screw head can be engaged with a hexagonal faceted sphere screwdriver, which permits implant-abutment off-axis inclinations of up to 28 degrees.[5] Nowadays, the angled screw channel abutment is compatible with many implant systems. A cone beam computed tomography (CBCT) analysis showed that screw-retained restorations were frequently achievable (76%) with the use of angled screw channel abutments compared to restorations with

straight abutments (24%). In addition, of the maxillary anterior teeth, the lateral incisors have a greater need for angled screw channel abutment.[6]

We present a case of labially tilted implants in anterior maxilla restored with screw-retained crowns. The angled screw channel abutment was applied to avoid unfavorable screw access from the labial surface.

Case Report

A 49-year-old female patient complained of a tooth mobility problem caused by a traffic accident three days previously. During intraoral examination, ill-fitted margins and grade III tooth mobility over bilateral maxillary central incisors were noted (Figs. 1 and 2). Periapical X-ray showed both teeth with an over-sized post and core and compromised tooth structure (Fig. 3). Given the remaining tooth structure and unfavorable prognosis, tooth extraction was suggested. After discussion of treatment planning with the patient, she agreed to placement of implants after tooth extraction. In CBCT analysis, the surrounding bone volume of the maxillary central incisors appeared to be suitable for immediate implant placement (Figs. 4 and 5). Bilateral maxillary central incisors were extracted and implants (Straumann®, BLT, RC, 4.1 × 12 mm) were placed simultaneously under flapless surgery (Figs. 6 and 7). The wound healed uneventfully following implantation. The provisional prosthesis was determined to be stable until maturation of the osseointegration. After allowing eight weeks for osseointegration, an impression of the implant was taken for fabrication of a provisional prosthesis. The angulation of the implant axis appeared to be tilted too labially when the impression copings were inserted (Fig. 8). The provisional implant restorations were delivered (Fig. 9). The final impression of the definitive prosthesis was taken three months later after the surrounding mucosa had matured (Fig. 10). The unfavorable angulation of the implant could have caused esthetic concerns if screw-retained restorations were planned. Therefore, angled screw channel abutments (Straumann® Angled solutions, AS) were determined to correct the implant angulations and avoid the complication of residual cement of cement-retained prostheses (Figs. 11 and 12). The definitive screw-retained implant restorations were delivered. The patient was satisfied with the esthetic appearance of the final prosthesis (Figs. 13–16).

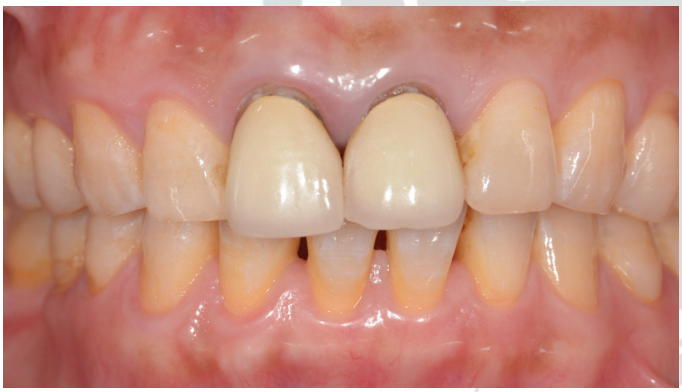

Figure 1. Initial frontal view showed ill-fitted margins on both maxillary cetral incisors

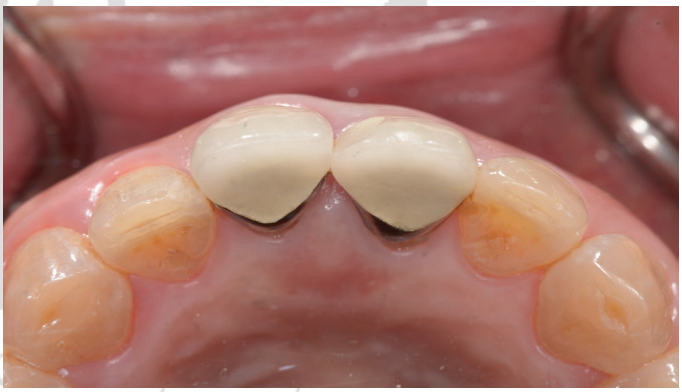

Figure 2. Initial occlusal view

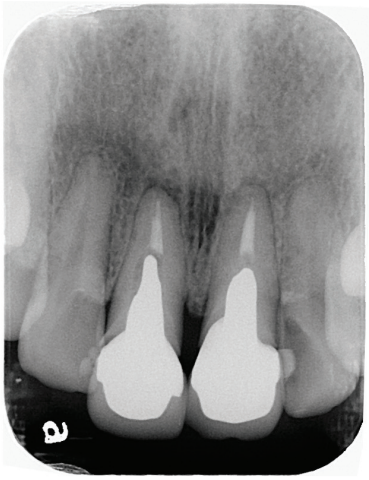

Figure 3. Initial periapical x-ray reveled over-sized posts

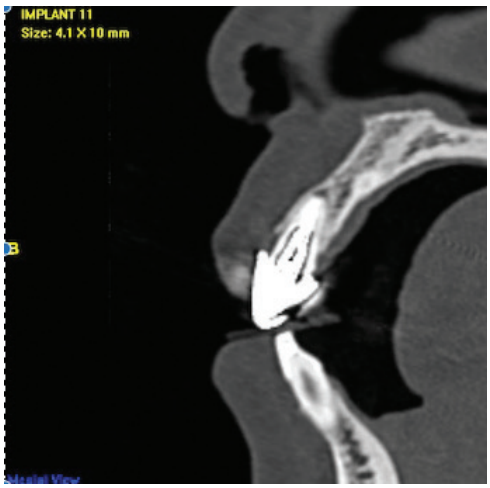

Figure 4. CBCT analysis of maxillary right central incisor

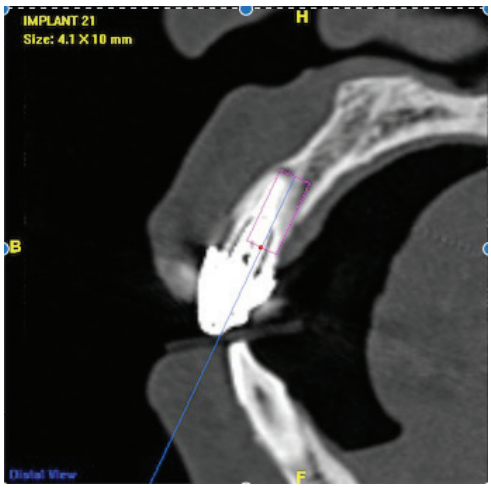

Figure 5. CBCT analysis of maxillary left central incisor

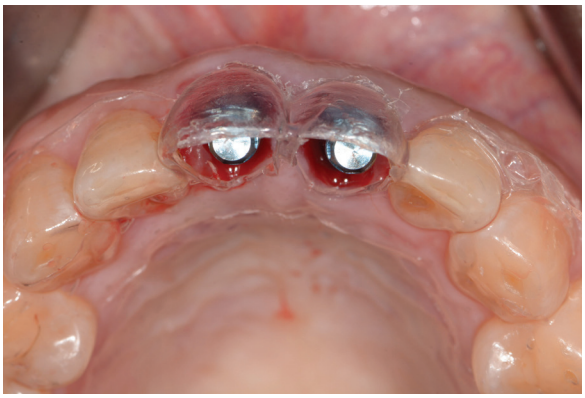

Figure 6. Implants were placed according to the surgical stent

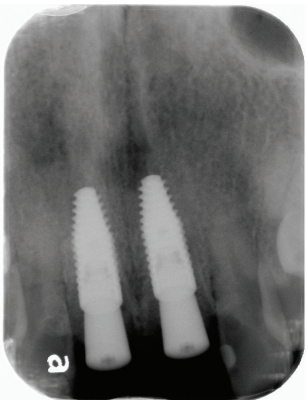

Figure 7. Periapical x-ray was taken after implants were placed

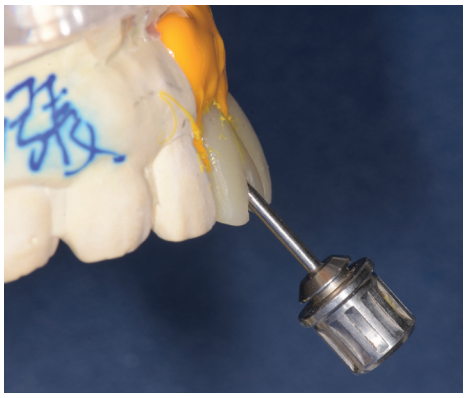

Figure 8. The angulation of implant appeared to tilted too labiallly

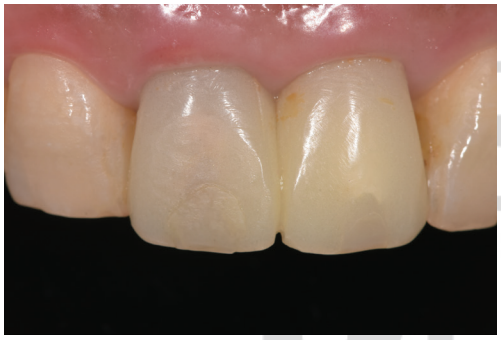

Figure 9. The provisional implant prosthesis was delivered

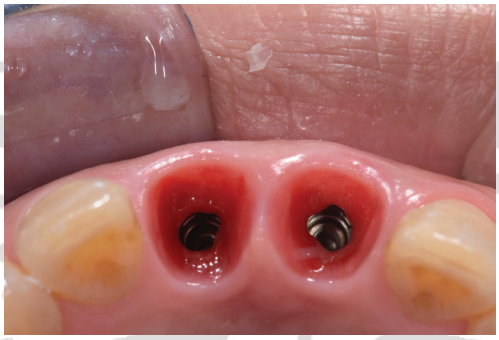

Figure 10. The soft tissue was modelled by provisioal restorations after 3 months

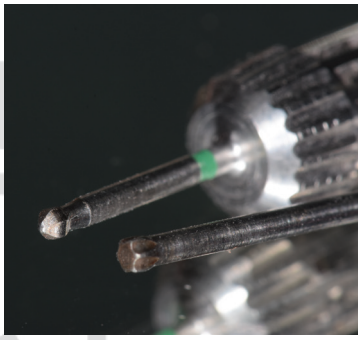

Figure 11. Close-up view of hexalobular surface of screw head

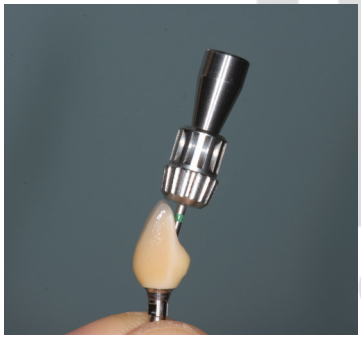

Figure 12. The screw access was corrected by angeled screw channel

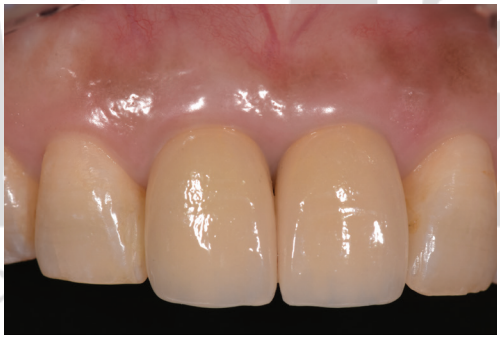

Figure 13. The close-up frontal view of definitive prosthesis

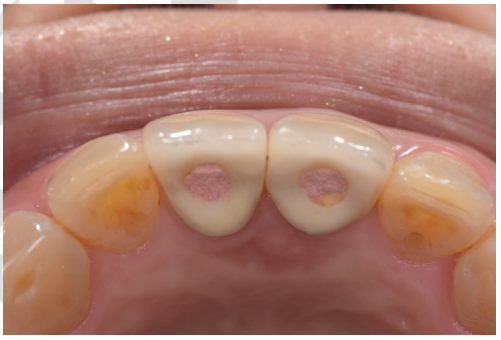

Figure 14. The occlusal view of definitive prosthesis. The screw access was located in the ideal position

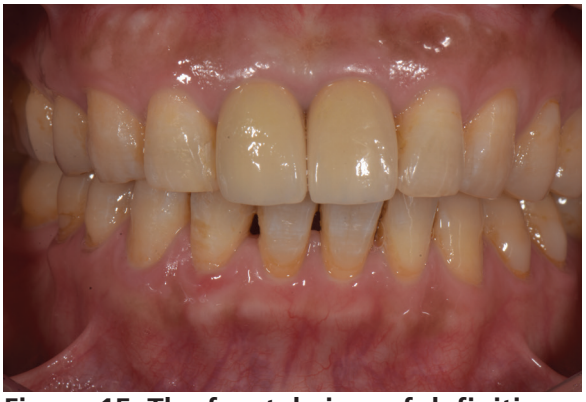

Figure 15. The frontal view of definitive prosthesis

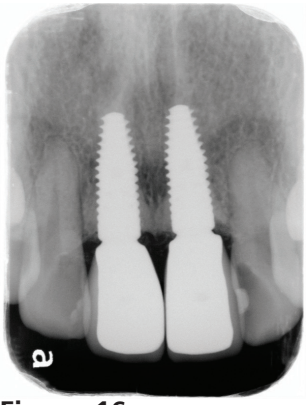

Figure 16. The periapical x-ray of definitive prosthesis

Discussion

Screw-retained restorations provide the advantages of retrievability and avoidance of the biological complications of residual cement in cement-retained restorations.[7] In cases of malposition of implant or unfavorable angulation, the angled screw channel can accommodate a screw channel angle of up to 28 degrees from the implant axis, while maintaining implant screw alignment.[5]

The various angulations of the angled screw channel may affect the torque value of the screw. This study demonstrated an off-axis angle within 0 to 15 degrees without significant loss of torque value. Nevertheless, at 25 degrees or above, the torque value is reduced significantly.[8] In various angled screw channel systems, the initial torque value affects the stability of the screw. The higher the recommended torque value of angled screw solutions is, the lower the likelihood of the screw loosening. In addition, angled screw channel restorations are comparable in performance to straight screw access restorations in terms of torque value after cyclic loading.[9,10]

In the case of fracture strength, laboratory studies have shown that angled screw channel restorations fail at fewer load cycles compared to straight screw. However, under a range of physiological force loadings, the fracture strength of angled screw channel restorations was comparable to that of straight screw restorations.[11–13]

Abutment thickness was influenced by the angulation of the angled screw channel, especially in the cingulum area of anterior restorations. Fractographic evidence indicated that the critical fracture point was initiated in the most apical part of the angled screw channel. In a clinical study, a similar fracture pattern also appeared in straight screw channel restorations.[14] The results indicated that the titanium base abutment interface design may play a more important role than the angulation of the screw channel. In addition, the more the angulation of the screw channel diverges, the less the thickness of the palatal surface of the anterior zirconia abutment. A catastrophic fracture could occur when the thickness of the restoration is reduced to less than 0.7mm.[15]

The CBCT study investigated the probability of use of screw-retained single crown following immediate implant placement and provisionalization in the esthetic zone. The overall frequency of use of the straight screw channel and angled screw channel was 14% and 84%, respectively.[16] The results indicated that the angled screw channel could be applied in a wider spectrum of sites than the straight screw channel, especially in the anterior maxillary area.

In the case of fracture resistance, the clinical and laboratory performance of angled screw channel restorations is comparable with the performance of straight channel restorations. However, multiple factors, such as initial torque value, configuration of the screwdriver, screw design, implant system, and angulation of screw channel, can affect the resistance of the screw to loosening.[17]

In a previous study, the clinical outcomes of angled screw channel restorations remained favorable for three years.[18] Only a small number of mechanical complications, including a loose screw, a ceramic fracture, and an implant failure, were reported in three clinical studies.[19–21] These complications were similar to those seen in conventional screw-retained implant restorations. No significant differences were found between angled screw channel restorations and straight screw channel restorations.

Angled screw channel solutions can overcome the drawbacks of traditional screw-retained restorations in divergent implant angulation. The treatment options appear to offer favorable results in short-term observations. However, long-term prospective clinical studies are needed to confirm the efficacy of the application.

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Case Report

Temporomandibular joint osteoarthritis diagnosed with cone beam computed tomography and its conservative management: a case report

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Abstract

Temporomandibular joint (TMJ) osteoarthritis is a debilitating degenerative disorder causing inflammatory conditions and osseous changes in the joints. Degeneration of the TMJ condyle can lead to malocclusion and skeletal deformity, chiefly retrognathism, accompanied by anterior open bite and facial asymmetry. This case report describes a 29-year-old female patient with symptoms of degenerative changes in the TMJ. Cone beam computed tomography images showed erosion and concavity of and subchondral cyst formation in the right condyle, loss of continuity of the articular cortical bone, and mild sclerosis of the left condyle. Occlusal pivot splint therapy and muscle relaxation training resulted in gradual and significant restoration of the erosive bony concavity and regaining of the intact cortical lining of the right TMJ condyle. Other favorable clinical outcomes included disappearance of the crepitus sound, mouth-opening limitation, and facial asymmetry. Favorable treatment responses were verified in this patient with improvement of clinical features and longitudinal osseous changes in the TMJ condyle..

Key words: cone beam computed tomography, occlusal pivot splint, osteoarthritis, temporomandibular joint

Introduction

Temporomandibular disorders (TMDs) involve the temporomandibular joint (TMJ), masticatory muscles, and/or associated structures. Possible conditions that affect the TMJ include disc displacement, TMJ sounds, congenital malformation, and degenerative joint disease[1]. Osteoarthritis (OA) is a degenerative condition of the joint characterized by deterioration and abrasion of articular tissue and concomitant remodeling of the underlying subchondral bone due to the overloading of the remodeling mechanism[2–4]. Symptoms of TMJ OA include pain, joint sounds such as crepitus, joint stiffness, restriction of mandibular movement[5,6], and most critically, joint deformity that can be recognized through radiographic imaging[7]. Osseous changes of TMJ OA involve erosion, joint mice , subchondral bone cysts, flattening, sclerosis, and osteophyte formation. Degeneration of the TMJ condyle can lead to malocclusion and skeletal facial deformity, chiefly retrognathism, accompanied by anterior open bite and facial asymmetry. Clinical evidence of the disease is seen

in 8–16% of the population[8] and may be unilateral or bilateral. The disease shows high prevalence among women[9], which may be due to estrogen receptor alpha polymorphisms, and is associated with increased susceptibility to pain in female TMJ OA patients[10].

In the early stages of disc derangement, signs of osteoarthritis are not manifest; moreover, it may persist for many years without development of radiographically perceptible changes or symptoms. Disc derangement in later stages may possibly parallel osteoarthritic changes but they may also represent independent processes[11], and 50% of patients will show some active cellular osteoblastic or osteoclastic activity[12]. Risk factors of OA include age, genetics, trauma, disturbances of joint or muscle, and systemic conditions; the etiology is complex and multifactorial[13,14]. Its etiopathogenesis involves a sustained inflammatory process leading to early damage to the cartilage due to metabolic and mechanical factors[15]. A series of biomechanical changes initiated in the hard and soft tissue of the joint triggers the immune response. Various inflammatory mediators, such as cytokines and chemokines, are released coupled with the activation of the complement system by the release of cartilage-degrading factors, such as matrix metalloproteinases and prostaglandin E, which further damage the articular cartilage. The initiation of a local inflammatory response results in the eventual degradation and abrasion of joint cartilage and the remodeling of the subchondral bone[14].

The TMJ condyle is surrounded by various structures that make detailed visualization of the bony status with plain radiography difficult. In a relatively short period, cone beam computed tomography (CBCT) has emerged as a cost- and dose-effective imaging modality for diagnostic evaluation of a variety of TMJ conditions in multiple dimensions. CBCT is superior to conventional radiographic examinations and magnetic resonance imaging (MRI) for the assessment of osseous TMJ abnormalities. However, it should be emphasized that the diagnostic information obtained is limited to the morphology of the osseous joint components, cortical bone integrity, and subcritical bone destruction/production. Therefore, MRI is the method of choice for evaluation of soft-tissue abnormalities and inflammatory activity in patients with TMDs[16].

The treatment of TMJ OA should be directed at suppressing the active inflammatory process, preserving function, preventing further deformity, and relieving pain[14]. Recently, invasive methods have become increasingly popular despite little scientific evidence of their effectiveness compared to that of noninvasive treatments[5]. Minimally invasive treatments include procedures that involve application of corticosteroids, local anesthetics, and plasma-rich growth factors into the joint[17], as well as arthrocentesis in combination with hyaluronic acid injections[18]. Noninvasive treatments include patient education about different relaxation techniques, physical therapy, interocclusal appliance therapy, and medications for alleviating symptoms. Occlusal stabilization splint therapy and nonsteroidal anti-inflammatory drug administration show a significant and positive long-term effect on the prognosis of TMJ OA; however, they can be accompanied by pain, indicating unfavorable prognosis with additional bone destruction[19].

Aging increases the level of calcium in the articular disk; therefore, it becomes stronger but less elastic and less able to deal with overload[14,20]. However, severe cases of OA may be found in a much younger population, particularly women of around 35 years of age. These patients tend to have a history of macrotrauma. Furthermore, female reproductive hormones, especially estrogen with its influence on the catabolism of cartilage–fibrous tissue of the joint, may play a special role in the development of OA[21]. However, the etiology and pathophysiology of OA is not clearly defined and its initiation is complex and depends on many external and internal risk factors. We report the case of a 29-year-old adult female with symptoms of degenerative changes in the TMJ. This case report presents the goals and possibilities of conservative therapy for OA and demonstrates how severe cases of OA can also be found in the younger population.

Case report

The 29-year-old female patient was referred from the local orthodontic clinic for evaluation of TMJ before orthodontic treatment. The patient reported persistent clicking noises during normal functional movements and chewing pain for more than five years; moreover, fully opening the mouth was occasionally difficult. A routine digital palpation of the masticatory muscles elicited pain in the bilateral temporalis, masseter, sternocleidomastoideus, and posterior cervical muscles (e.g., the splenius capitis and trapezius). Crepitus of the right TMJ was detected with palpation and the limited opening of

the mouth was found, with it opening unassisted only for 36 mm. The application of the end-feel test failed to increase the interincisal distance. During mouth opening, pathway deflection to the right side without returning to the midline was observed. Signs of clenching over the buccal mucosa and tongue border were inspected. A diurnal parafunctional habit was acknowledged by the patient.

Digital palpation of the bilateral TMJs when the mandible was stationary and during dynamic movement did not cause tenderness. Examination of the habitual intercuspal position showed that the chin was deviated to the right by 3 mm from the facial midline. During attempts to guide the mandible into centric relation, the chin shifted to coincide with the facial midline. Panoramic radiography analysis revealed that the patient's teeth 36 and 46, which were missing for a long time, were without prosthodontic restoration. Teeth 18 and 28 were erupting, while teeth 37, 38, 47, and 48 were mesially tilting. Panoramic radiography showed mild flattening and a little short of right condyle (Figure 1). Since panoramic radiography has limited display options for the degree and severity of bone destruction, CBCT was used to diagnose osteoarthritis of the TMJ. CBCT images were acquired using KaVo 3D eXam (KaVo Dental GmbH , Biberbach, Germany) with 0.5-mm focal spot size and 0.2-mm voxel size. Corrected sagittal, coronal, and axial images of the TMJs were reconstructed along the true axes of the mandibular condyle at a slice thickness of 0.25 mm. The coronal view of the right condyle showed erosion, concavity, and subchondral cyst formation; in addition, loss of continuity of the articular cortical bone and mild sclerosis of the left condyle were observed (Figure 2). TMJ OA was diagnosed based on the identification of typical osteoarthritic changes in the TMJ articular surface.

The patient was instructed to restrict jaw movement to within painless limits, especially when yawning. A soft diet was initiated, along with slower chewing and smaller bites. An occlusal pivot splint was fabricated from hard acrylic resin. The 2-mm thick splint allowed only a single contact between the teeth, i.e., posteriormost contact between the opposing second molars, by repositioning the mandible to the centric relation position. The patient was instructed to wear the splint during the night and was informed that the teeth should be positioned without contact, except during chewing and swallowing. The patient was asked to make a conscious effort to keep the teeth apart during all waking moments and to keep the jaw-elevator muscles relaxed when the splint and teeth came into contact. The patient was followed up every two months for two years after the splint was prescribed. After regular wearing of the splint for about four months, the mouth opening measured 43 mm without a deviated pathway. Mild muscle tightness was felt during palpation and chewing hard food. Palpation of the lateral condyle pole did not cause pain, and crepitus of the right TMJ disappeared. After 18 months, during observation of the mouth-closing pathway, the chin shifted to automatically coincide with the facial midline without guiding the mandible. Longitudinal bone changes due to TMJ OA were evaluated between the first and the two-year follow-up CBCT image sets (Figure 3). Restoration of the erosive bony concavity led to the gradual recovery and regaining

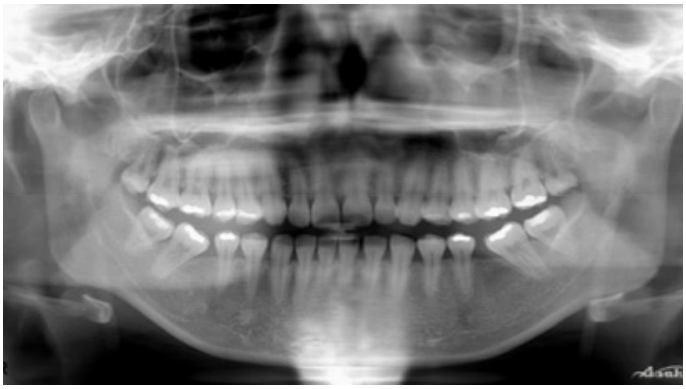

Figure 1. The panoramic radiography showed mild flattening and a little short of right condyle

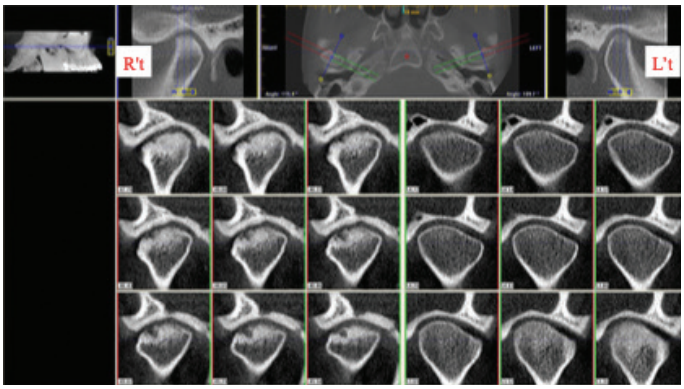

Figure 2. Osteoarthritic changes of the TMJ on CBCT showed the coronal view of right condyle with erosion, concavity and subchondral cyst formation; loss of continuity of the articular cortical bone and mild sclerosis of left condyle

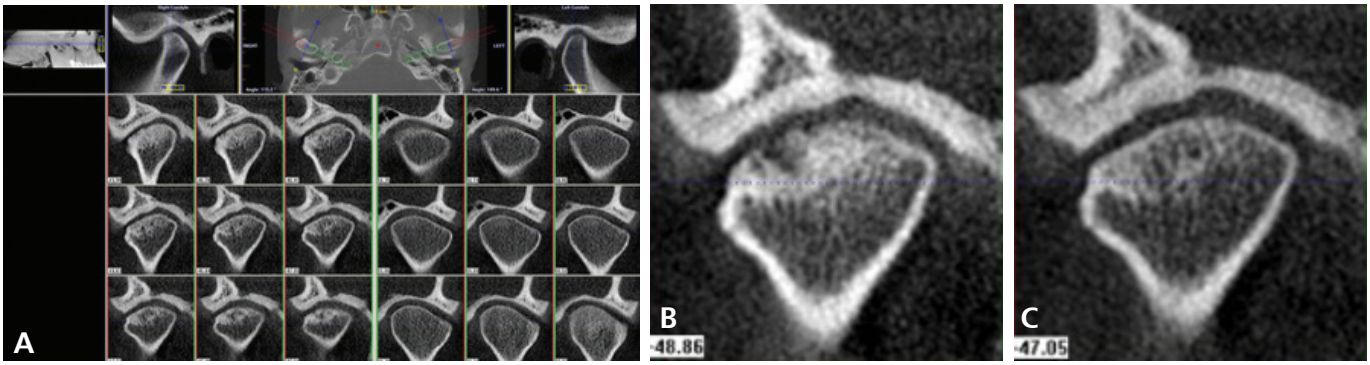

Figure 3. Follow-up CBCT image after two years (A), longitudinal bone change was evaluated between initial (B) and follow-up image (C) displayed restoration of erosive bony concavity gradually recovered and regained intact cortical lining of right TMJ condyle.

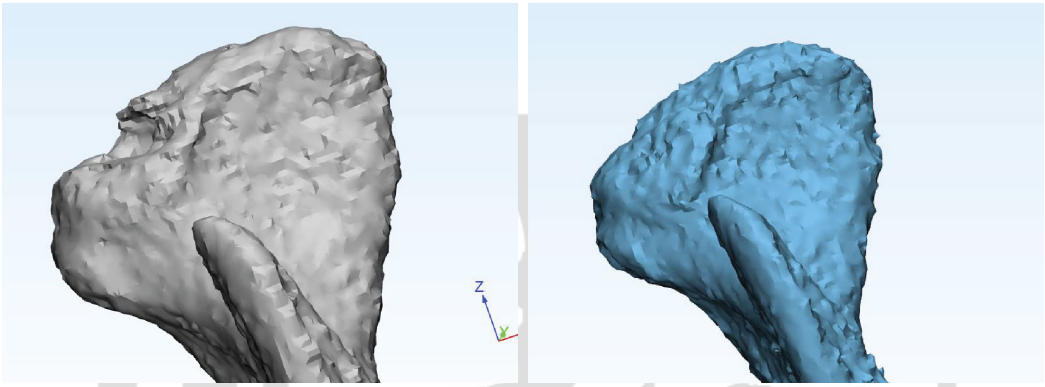

Figure 4. MIMICS software for segmentation and a 3D model of the right TMJ condyle head acquired could be used to display the quantity of bone formation.

of the intact cortical lining of the right TMJ condyle. These DICOM image files of CBCT were input into MIMICS software (Materialise's Interactive Medical Image Control System, Belgium) for segmentation, and a 3D model of the right TMJ condyle head was used to display the quantity of bone formed (Figure 4). Long-term assessment of clinical and radiographic data focusing on longitudinal osseous changes showed good clinical outcomes. Dental procedures such as orthodontic treatment and fixed partial denture fabrication can be prescribed for this patient in the future.

Discussion

Temporomandibular joint OA is a relatively common phenomenon in patients complaining of TMD symptoms, but it can also be incidentally identified during the course of any dental procedure. Deformity of the TMJ condyle due to OA can be easily visualized and confirmed with imaging modalities, such as CBCT, which provides high-resolution multiplanar reconstruction of the TMJ[22] with a low radiation dose and without superimposition of the bony structures. CBCT improves qualitative analyses of the condylar surface and detection of the condylar shape. The most common radiographic findings are flattening, erosion, and osteophytes, followed by sclerosis. OA is generally considered an age-related condition and is found predominantly among females; however, the linear correlation between bone change and age observed for other joints is not observed for the TMJ. TMD is most prevalent in young adults in their 20s to 40s; TMJ OA may begin at a very early age[23,24].

Song et al. analyzed longitudinal serial CT image sets of TMJ OA with a mean follow-up period of 644 ± 325 days; therefore, resolution of the destructive changes could be observed in numerous cases (42% of total evaluated joints)[19]. Lei et al. found a 62.7% (42/67) regeneration rate of the TMJ condyle in young adults with early-stage OA—78.1% in the anterior repositioning splint treatment group (25/32) and 48.6% in the control group (17/35)[25]. These results demonstrate that the TMJ with erosive destruction of condyle surfaces, which generally appears as sclerosis and flattening of the condyle morphology in radiographic images, can gradually recover and regain an intact cortical lining over an extended period. In the nondestructive remodeling stage without surface erosion or subchondral bone cysts, the condyle

may be expected to endure the loading that occurs during daily jaw functioning, without progressive inflammation[26].

Temporomandibular joint OA has also been investigated in asymptomatic patients with different dentofacial deformities. Results showed that OA was more frequent among those with skeletal jaw discrepancies (Class II patients, in particular) than among those without jaw discrepancies[27]. Patients with TMJ OA accompanied by pain may show additional osseous destruction, which must always be evaluated in the initial diagnostic process and treated more aggressively to control the pain. Inflammatory cytokines directly evoke pain and also contribute to the additional osseous changes of the condyle; this suggests a shared pathway between pain transmission and bone resorption[28]. Cevidanes et al. showed that the extent of resorptive changes in the OA condyle is closely related to the duration and severity of pain[29].

The young patient in this case report presented with osteoarthritic changes accompanied by crepitus, facial asymmetry, and limited mouth opening. The primary therapeutic goal was to resolve the crepitus and increase the range of motion. The patient was treated with a combination of pivot splint and muscle relaxation training and was seen at followed-up consultations every two months. At four months of follow-up, the patient reported improved symptoms, including a straight mouth-opening pathway without deviation and clicking sounds, a normal range of motions, and no joint pain. Facial asymmetry was improved due to deviation of the chin to coincide with the facial midline and about a 1-mm offset from the habitual intercuspal position. Chang et al. clarified that the action of the pivot splint, which distracts the condyle away from posterior attachment tissue (in the case of displaced disk), is due to the net clenching forces located anterior to the pivot. Therefore, we expected a reduction in unfavorable upward stresses in the TMJ[30]. If the disk is in place and is being abused by a clenching or bruxing habit, distraction of the condyle would allow for a loose-pack joint position and a decrease in harmful stimuli[31]. Favorable treatment responses were verified in this patient with improvements in clinical features and longitudinal osseous changes of the TMJ condyle.

Several treatment modalities effective for improving the symptoms of TMD were investigated in previous studies. Behavioral modification, physical therapy, medication, occlusal splint therapy, intra-articular injection, and surgical procedures have been applied to manage TMJ OA[32–35]. However, few studies investigating treatment efficacy have focused on bone changes in TMJ OA. Song showed that occlusal stabilization splint therapy and nonsteroidal anti-inflammatory drugs have a significant influence on TMJ OA prognosis[19]. When weighing treatment options for TMD, invasive methods should be considered only for a small percentage of patients that do not respond to less invasive therapy.

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Journal of Prosthodontics and Implantology

Introduction for authors

Types of article

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

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

General Format guide

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

Review Articles Format Guide

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

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

Original Articles Format Guide

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

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

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

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

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

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

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

Technique Reports/ Case Reports Format Guide

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

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

Letters to the Editor Format Guide

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

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

Manuscript Preparation

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

The detailed specifications of the manuscript content are as follows:

➢ ***Title page***

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

➢ ***Abstract and keywords***

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

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

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

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

➢ ***Main Text***

(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.
- The title and detailed description of the illustration must be typed double-spaced on a separate page. Photomicrographs should include an internal scale marker to indicate the magnification.
- 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.
- All symbols and abbreviations should be defined in the figure legend in alphabetical order.

➢ ***Tables***

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.

Submission List

- 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.
- Confirm titles and footnotes for all tables, and detailed titles and descriptions for figures. Type them double-spaced on separate pages.
- Verify that all tables and figures are formatted correctly. Tables and figures are stored in separate folders and not included in the main text.
- If the research involves human subjects, the consent from the institutional review board or ethics committee must be attached.
- Letter of consent signed by all authors.

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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：

1. 學術綜論（review article）
2. 研究論文（original artic1e）
3. 技術報告（technical report）
4. 病例報告（case report）
5. 給編輯的信（Letter to editorial）

二、稿件撰寫一般格式：

1. 文章必須是沒有刊於或將被接受刊於其他雜誌。
2. 英文投稿，文章內容以複行（double spacing）繕打，字體大小12以上，其每邊邊緣至少須留2.5公分，不須任何格式編排。
3. 全文總頁數（包括摘要、圖、表、參考文獻）以八頁為限，必要時可增至十二頁。
4. 請以電子文件投稿，文書處理程式建議以IBM-Microsoft Word為主。
5. 須標示使用程式、投稿題目、第一作者姓名，將電子文件E-mail至：prosthor@ms48.hinet.net。
6. 請同時附上致本誌主編簡短信函，表明投稿本誌之意願，並說明所有著者均曾過目並簽名同意。若為人體試驗須附人體試驗委員會之同意函。

三、稿件內容詳細規格如下：(詳細撰寫格式，請參閱JPI 英文指引)

1. 首頁（title page）：包括題目、作者姓名、服務單位、學歷；英文簡題（running title）長度在四十個字以內；稿件主要負責者（corresponding author）之英文姓名與地址、電話、傳真、e-mail。
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。
3. 本文（text）：
   (1) 學術綜論（review article）－無一定格式。
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   - 前言（introduction）：簡要說明研究由來。
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   - 結果（results）：研究結果以文字、表格或插圖表示之。
   - 討論（discussion）：強調重要結果與論點，與前人論述作比較等。
   - 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。

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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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   (1) 插圖請勿放置於本文中，也不要編排，應儲存於另外的檔案夾。影像圖檔應以 JPG、EPS 或 TIF 格式存檔。插圖以電子檔 e-mail 傳送投稿。

   (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（internal scale 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、Photompact、Illustrator 等。彩色或灰階圖形須掃瞄至 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。

6. 表格（tables）：每一表格應為單獨一頁，須有標題及詳細說明，複行繕打，並冠以阿拉伯數字順序。

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- 致主編簡短信函。
- 提供稿件主要負責者之姓名與地址（中英文）、電話、傳真、e-mail、所有作者之服務機構（英文）。
- 附英文摘要（400 字以內），研究論文的摘要應分研究目的、方法、結果、主要結論。
- 附英文關鍵詞（5 個以內）；附英文簡題（長度在 40 個字以內）。
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- 確認所有圖表皆符合格式。圖表皆儲存於另外的檔案夾，而未放置於本文中。
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