A Retrospective Comparative 8-Year Study of Cumulative Complications in Teeth Adjacent to Both Natural and Implant-Supported Fixed Partial Dentures

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Purpose: To compare the complication rate of natural teeth adjacent to implant-supported dentures (IFDs) with that of teeth serving as abutments for fixed partial dentures (FPDs). The second goal was to assess the risk factors for complications in teeth adjacent to bounded edentulous spaces. ***Materials and Methods:*** The study subjects were selected from patients who received prosthodontic treatment for their bounded edentulous space not exceeding two missing teeth between February 1990 and March 2007. Sixty-one patients were included in the IFD group and 66 patients were included in the FPD group. Tooth complications were defined as tooth extraction, periodontal lesion, periapical lesion, and loss of prosthesis and were assessed by one examiner based on dental records. ***Results:*** The 8-year cumulative complication rate for the IFD group (7.9%) was significantly lower than for the FPD group (40.7%). Additionally, the 8-year cumulative complication rate of vital teeth (6%) was significantly lower than that of nonvital teeth (45.9%). A cox proportional hazard analysis revealed that nonvitality of dental pulp was a significant risk factor for tooth complications, whereas treatment modality was not. ***Conclusions:*** Teeth adjacent to IFD-treated edentulous spaces presented fewer complications than natural teeth serving as abutments for FPDs. Conservation of teeth adjacent to edentulous spaces as vital teeth was the key finding to limit further tooth loss. *Int J Prosthodont 2013;26:260–264. doi: 10.11607/ijp.3120*

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Prosthodontic treatment interventions for managing partial edentulism seek to preclude time-dependent and adverse intraoral ecologic changes. For example, published evidence suggests such long-term changes in teeth adjacent to bounded edentulous spaces depend on the type of treatment.[1–3]

In a 10-year retrospective study with 317 patients who had posterior bounded edentulous spaces, Aquilino et al observed that spaces restored with a fixed partial denture (FPD) had significantly longer survival or more favorable outcome estimates (92%) than those that remained untreated (81%), while removable partial dentures (RPDs) had the poorest survival rate.[4] Similar results had already been reported by Shugars et al, who showed that the survival curve of teeth adjacent to posterior bounded edentulous spaces was worse for those left untreated and restored with RPDs than for those with FPDs.[5]

It has also been speculated that implant-supported dentures (IFDs) can actually serve to protect teeth adjacent to the edentulous space, although there has been little documentation to support this observation. Krennmair et al investigated the status of

teeth adjacent to single-tooth implants (n = 78) and observed that while no adjacent tooth was lost, four (3%) required intervention during the 3-year follow-up period.[6]

The present investigation was conducted as part of a series of studies that separately evaluated the prognosis of remaining teeth adjacent to different types of edentulous spaces (bounded edentulous, unilateral distal extension edentulous, and large bounded edentulous) treated with IFDs. The data reported in the present investigation are limited to bounded edentulous prosthodontic treatment. In addition, risk factors for complications associated with teeth adjacent to the spaces in either IFD or FPD situations were tabulated and assessed. The null hypothesis was that no significant difference in complication rates would be observed between the two treatment options.

Materials and Methods

Study Population

Two study groups were selected from the patient population seeking treatment for no more than two missing adjacent teeth at the Fixed Prosthodontic Clinic of Okayama University Hospital, Okayama, Japan. The IFD group comprised a consecutive series of 84 patients who were treated between February 1990 and March 2007. Patients (n = 23) whose preoperative or postoperative radiographic images were unavailable were excluded, which left a total of 61 patients (23 men, 38 women) with a mean age of 46.0 ± 15.0 years enrolled in this particular IFD group.

The FPD group of 66 patients (26 men, 40 women) with a mean age of 50.5 ± 15.4 was selected from the 2,214 patients treated between January 1998 and December 2006. They comprised a matched group based upon sex, age, and number of missing teeth as determined from dental and laboratory records. All treatments were performed by residents, postgraduate students, and faculty staff, and the study's protocol was approved by the Ethical Committee for Human Research in Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences (no. 213).

Classification of Tooth Complications and Censored Cases

The condition of the abutment teeth or teeth adjacent to the IFD was assessed by one investigator (SY) from hospital records. The follow-up period started on the date when the final restoration (IFD or FPD) was completed and ended on March 31, 2007. Follow-up visits were scheduled at least once every 6 months, and the treating dentist checked the status of all restorations and the periodontal condition.

The primary endpoint was established when biologic or technical complications were described in the dental records. Complications were defined as tooth extraction, periodontal lesion, periapical lesion, or loss of the prosthesis. Diagnoses of periodontal and periapical lesions were based on patients' subjective complaints as well as clinical and radiographic examinations. Patients who did not return to the hospital within 2 years prior to the end of the study were regarded as censored cases, for whom the complication-free period was established to be from the date of final treatment completion to the last follow-up visit.

Statistical Analysis

The chi-square (χ^2) test and *t* test were used to compare baseline data between IFD and FPD groups regarding sex, age, missing unit, remaining number of teeth, functional duration of prosthesis, and vitality of dental pulp of intended teeth. Survival rates were calculated by Kaplan-Meier analysis.[7] The log-rank test was used to compare the survival curves between the two groups.[8] Finally, the Cox proportional hazards regression model with an intention-to-treat regime was used to calculate the relative risk for complications of each predictor variable. The significance level was set at $P < .05$.

Results

Baseline Data

As shown in Table 1, baseline data comparison revealed no statistical difference between IFD and FPD groups in regard to sex ratio (male/female: 23/38 for the IFD group; 26/40 for the FPD group; $P > .05$) or mean age at prosthesis insertion (IFD: 46.0 ± 15.0 years; FPD: 50.5 ± 15.4 years; $P > .05$). However, there was a significant baseline difference in regard to dental pulp vitality between the two groups ($P < .01$).

Survival and Complication Rates

During the observation period, a total of 24 complications were observed (IFD group: 6; FPD: 18): fracture or loss of retention of the prosthesis (IFD group: 4; FPD group: 9), periodontal lesion (IFD group: 2; FPD group: 4), and periapical lesion (IFD group: 0; FPD group: 5).

Table 1 Demographic Data of IFD and FPD Groups

	IFD group (n = 61)	FPD group (n = 66)	*P*
Sex			.776*
Male	23	26	
Female	38	40	
Mean age (y)	46.0 ± 15.0	50.5 ± 15.4	.094†
Missing unit			
Single	34	42	.075*
Double	27	24	
Maxilla	62	76	.703*
Mandible	60	56	
Anterior	55	56	.417*
Posterior	67	76	
Remaining teeth	24.1 ± 3.1	23.2 ± 3.6	.148†
Functional duration (y)	3.7 ± 2.9	3.5 ± 2.7	.639†
Vitality of dental pulp			
Vital	90	45	< .01*
Nonvital	32	87	

IFD = implant-supported denture; FPD = fixed partial denture.
*χ^2 test.
†*t* test.

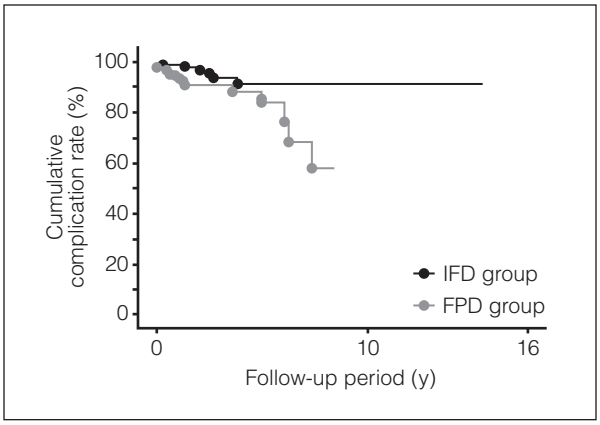

Fig 1 Eight-year cumulative complication curves of IFD (92.1%) and FPD (59.3%) groups. A significant statistical difference was observed by the log-rank test (*P* = .02).

Table 2 Incidence of Tooth Complications According to Dental Pulp Vitality

	Loss of prosthesis		Periodontal lesion		Periapical lesion		Total	
	IFD group	FPD group	IFD group	FPD group	IFD group	FPD group	IFD group	FPD group
Vital (n = 135)	1	1	1	1	0	0	2	2
Nonvital (n = 129)	3 (1)	8	1	3 (1)	0	5	4 (1)	16 (1)
Total	4 (1)	9	2	4 (1)	0	5	6 (1)	18 (1)

IFD = implant-supported denture; FPD = fixed partial denture.
( ) = extracted tooth number.

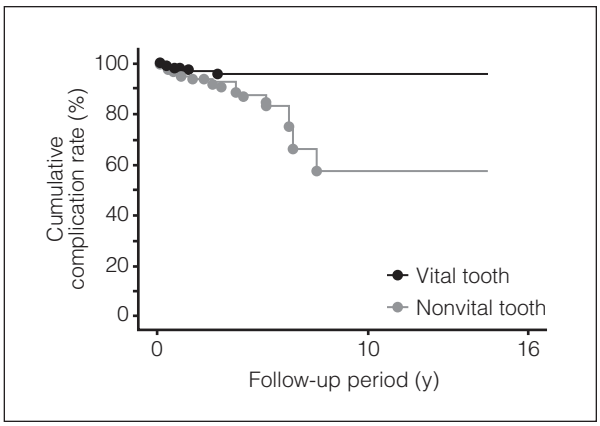

Fig 2 Eight-year cumulative complication curves of vital (94.0%) and nonvital (54.1%) teeth adjacent to edentulous spaces. A significant statistical difference was observed by the log-rank test (*P* = .04).

A Kaplan-Meier analysis indicated that the 8-year cumulative survival rate of the IFD group (92.1%) was significantly higher than that of the FPD group (59.3%; log-rank test, *P* = .02, Fig 1).

Since a significant difference was observed between the two groups regarding dental pulp vitality, a more detailed analysis of the relationship between dental pulp vitality and natural tooth compromise was performed. As shown in Table 2, 20 complications occurred in nonvital teeth (IFD group: 4; FPD group: 16), and 4 complications occurred in vital teeth (IFD group: 2; FPD group: 2). The important association between dental pulp vitality and tooth complications led the authors to compare the complication rates of vital and nonvital teeth adjacent to edentulous spaces. A Kaplan-Meier analysis showed that the 8-year cumulative complication rate of vital teeth (6%) was significantly lower than that of nonvital teeth (45.9%; log-rank test, *P* = .04) (Fig 2).

Risk Factors for Complications in Adjacent Teeth

Based on the analyses that revealed a significant association of treatment group difference and dental pulp vitality with tooth complications, a Cox proportional hazard test was performed to analyze whether these two factors could be real predictor variables for tooth complications (Table 3). As a result, nonvitality of dental pulp was the significant risk factor (relative ratio: 2.72; 95% confidence interval [CI]: 1.01 to 7.31) for tooth complications.

Table 3 Risk Factors for Complications in Teeth Adjacent to Bounded Edentulous Spaces*

	RR	*P*	95% CI
Treatment group: FPD	2.016	.165	0.185–1.334
Vitality of dental pulp: nonvital	2.720	.047	1.012–7.310

RR = relative risk; CI = confidence interval; FPD = fixed partial denture.
*Cox proportional hazard regression.

Discussion

The present retrospective clinical study appears to be the first to compare the survival of adjacent teeth to bounded edentulous spaces treated with IFDs or FPDs. The results of the Kaplan-Meier analysis indicated a lower complication rate for the IFD group vs the FPD group (log-rank test, $P = .02$), which suggests a rejection of the null hypothesis.

As shown in Table 2, a higher incidence of periodontal and periapical lesions was observed in the FPD group. The periodontal condition of a tooth, such as the amount of remaining periodontal structure and presence/absence of inflammation, is known to be a relevant factor in tooth survival.[9] The present investigation did not directly control for the periodontal condition or oral hygiene habits because it was a retrospective cohort study, and therefore a bias effect from these factors cannot be ruled out. Nevertheless, the matching of subjects' age, sex, and number of missing teeth between the two groups could indirectly decrease bias from these conditions.

Another factor that could induce bias in the present results was nonrandomization of treatment selection, which was determined according to the patient's preference and could partially explain the baseline intergroup discrepancies regarding the risk factors (ie, vitality of dental pulp). For instance, important factors that patients may have considered when selecting their treatment modality could include submitting to surgical procedures (inevitable in dental implant therapy), as well as costs, which vary since implant treatment generally represents a more costly solution to managing partial or complete edentulism. Additionally, patients may have preferred IFD treatment when the teeth adjacent to bounded edentulous spaces were sound teeth to avoid unnecessary tooth preparation. Therefore, although prospective randomized controlled clinical trials would enable more reliable and valid results, sample randomization would encounter great barriers related to both ethical and economic standpoints.

Among the total of 24 teeth with complications, a notably higher amount of complications were observed in the nonvital (n = 20) compared to vital teeth (n = 4). Consequently, an analysis of the survival rates between vital and nonvital teeth (log-rank test) was performed, and the 8-year cumulative complication rate was shown to be significantly lower in the vital tooth group ($P = .04$). Moreover, to identify the risk factors for tooth complications, a Cox proportional hazard analysis was performed, which demonstrated that tooth complications were significantly related to nonvitality of dental pulp and not to the type of treatment. Therefore, these results indicated that the main risk factor for complications in the tooth adjacent to edentulous space not exceeding two missing teeth was the vitality of dental pulp, not whether an IFD or FPD was the treatment provided.

These findings parallel others that evaluated the survival rates of FPDs[10,11] and that reported weak significant differences in the survival rate of FPDs with vital vs nonvital abutment teeth. Another evaluation of treatment outcomes of four-unit porcelain-fused-to-gold FPDs (102 FPDs for 73 patients) replacing two adjacent missing teeth for up to 20 years showed a significant difference between the survival rates in the maxilla for the vital group and for the root canal–treated group.[12] These reported observations support the notion that a nonvital tooth is an important risk factor for eventual complications with the tooth itself or when used as an abutment tooth to support a prosthesis.

Additional interesting findings were reported by De Backer et al in an investigation on the long-term survival of posts and cores on root canal–treated (RCT) teeth restored with complete crowns (n = 1,037), FPDs (n = 322), three-unit FPDs (n = 134), and cantilever FPDs (n = 168) over a period of 16 to 20 years.[13] The recorded complications were related to loss of restoration or tooth and showed that there was no significant difference ($P = .602$) in survival rates for complete crowns between the vital

pulp group (74.9%) and the RCT group (79.4%) after 18 years.[13] However, for the FPDs, the survival rate at year 20 was 77.4% for the vital group and 56.7% for the RCT group with at least one RCT abutment (P = .002). These results suggest that dental pulp vitality is not a significant factor for teeth treated as single crowns, but when a tooth is treated as an abutment tooth for FPDs, it does influence the survival of the prosthesis. Indirectly, these results confirm the strong points of IFD treatment in terms of preservation of the adjacent teeth because it avoids tooth preparation as well as excessive bending overload on the adjacent teeth, which is particularly important when adjacent teeth are present in a nonvital condition. Future studies using unified samples on dental pulp vitality are promising and may help clarify which factor (treatment modality or dental pulp vitality) is more relevant in the prognosis of adjacent teeth.

Conclusions

The study's limitations demand caution in the interpretation of the reported observations. Nonetheless, a comparison of the cumulative complication rates between teeth adjacent to IFDs and abutment teeth of FPDs revealed that the 8-year cumulative complication rate for the IFD group was significantly lower than that for the FPD group. In addition, comparisons of survival rates between vital and nonvital teeth adjacent to bounded edentulous spaces revealed a significantly lower complication rate for the vital teeth.

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