Clinical and Radiographic Evaluation of Patients Receiving Both Tooth- and Implant-Supported Prosthodontic Treatment After 5 Years of Function

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Purpose: The aim of this research was to assess survival and complication rates of tooth- and implant-supported fixed dental prostheses (FDPs) and single crowns (SCs) after 5 years of function in a specific patient population group who underwent comprehensive prosthetic treatment. ***Materials and Methods:*** This retrospective study included a convenience sample of 52 patients who met specific inclusion and exclusion criteria and were treated during two specific courses as part of the undergraduate curriculum. The patients' prosthodontic treatment comprised 296 tooth-supported and 37 implant-supported SCs together with 76 tooth-supported and 15 implant-supported FDPs. Pre- and posttreatment clinical examinations included screening for biologic and technical complications, probing pocket depth, bleeding on probing (BoP), and plaque control record (PCR) as well as intraoral radiographs. Information was obtained from the patients about dental hygiene and dental visits, treated complications, and patient satisfaction during the observation period. Descriptive statistics were employed. ***Results:*** Forty-five patients were followed for a mean observation period of 5.26 ± 0.47 years. The survival rates were 99.0% for tooth-supported SCs, 98.7% for tooth-supported FDPs, and 100% for implant-supported FDPs and SCs. Loss of vitality was observed in 2.9% of all abutment teeth deemed to be vital initially. Endodontic complications occurred in 5% and root fracture in 2.5% of nonvital abutment teeth. Caries was found in 0.4% of abutments. No framework or implant fractures were observed, but fracture of the veneering ceramic affected 3.8% of FDPs. The mean BoP was 21.5% ± 9.9%, and the mean PCR was 22.8% ± 16.5%. A high satisfaction rating was provided by 82.2% of patients. ***Conclusions:*** High survival and relatively few complication rates were observed for all prescribed FDPs over the observation period. *Int J Prosthodont 2012;25:252–259.*

Diverse prosthodontic treatment options are currently available for patients who need comprehensive dental treatment. Several factors influence the dentist's treatment decision, such as clinical and radiographic findings, patient preference, financial considerations, professional skills, and experience. Moreover, published and rigorously compiled data on treatment outcomes with different protocols are an important part of the decision-making paradigm.[1–6] However, little information is available on clinical outcomes in patients who have undergone comprehensive treatment that involves combinations of different prosthodontic interventions.[7,8]

Favorable survival rates of approximately 95% at 5 years or longer have been reported for both tooth- and implant-supported prostheses, while complication rates appear to vary between the different types. It is also important to note that several studies do not provide detailed information on complications.[3]

Biologic complications include caries, loss of pulp vitality, periapical pathologies, and periodontal disease progression at teeth or peri-implantitis at implant abutments. Quite logically, tooth-supported fixed dental prostheses (FDPs) are reported to have a higher risk of biologic complications than implant-supported FDPs given that osseointegrated

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abutments are not vulnerable to either caries or pulpal disease. Nonetheless, a few recent studies in the periodontal literature suggest the possibility of a relatively high rate of peri-implantitis[9–11] associated with implant-supported prostheses. The latter suggestion is controversial and disputed by many other researchers.[12,13] Therefore, it remains unknown whether the overall occurrence of long-term biologic complications associated with implant-supported FDPs will be significantly lower than what is found in association with tooth-supported FDPs.

Technical complications comprise loss of retention, fracture of the abutment tooth or implant, fracture of the framework or veneering ceramic, and loosening or fracture of screws. Among the major complications, implant or framework fractures are rare at both tooth- and implant-supported FDPs.[4–6] However, fracture of tooth abutments occurs in approximately 2% to 3% of abutments.[3,6] Regarding minor complications, implant-supported FDPs are reported to have a higher tendency for technical complications such as fracture of the veneering ceramic than tooth-supported FDPs.[1–4,6,14] Another frequent technical complication in implant-supported FDPs is screw loosening.[1,4] These minor technical complications, although troublesome, can often be treated without losing the prosthesis.

The aim of this study was to assess the 5-year survival and complication rates of tooth- and implant-supported single crowns (SCs) and FDPs in a specific patient population who underwent comprehensive prosthetic treatment.

Materials and Methods

This retrospective clinical study included 52 patients who were treated by undergraduate students in their final year during two specific courses between 2001 and 2003. The patients who were selected for these courses met the following inclusion and exclusion criteria: requiring prosthetic treatment of at least eight occlusal units, willingness to be treated by undergraduate students with an increased treatment time, motivation to improve oral hygiene, and no severe systemic illness. There were no limitations regarding patient age.

All patients were treated according to a standard therapeutic concept, and the students were supervised closely by faculty members. The initial visit included obtaining medical and dental histories, inspection of the oral mucosa, analysis of function, analysis of the dental hard and soft tissues, periodontal examination, analysis of the occlusal contacts, and registration of the pattern of articulation. Based on the information gathered, a diagnosis was made. Subsequently, a treatment plan was developed and presented to the patient. After further discussion, a modified treatment plan was adopted.

Treatment was divided into different phases, starting with a systemic phase, which comprised patient information about smoking cessation programs and included contacting the patient's general practitioner for specific cases of mild systemic illness, such as type 2 diabetes. During the following standard hygienic phase, gingivitis or moderate chronic periodontitis were treated. A high level of oral hygiene (plaque control record [PCR] and bleeding on probing [BoP] < 20%) had to be maintained during all phases of treatment. In some patients, a periodontal therapy surgical phase was necessary to resolve periodontitis. After successful completion of periodontal therapy, verified by reevaluation, implants (Brånemark, Nobel Biocare or Straumann) were placed by faculty members. The implants were allowed to heal for 6 months in the maxilla and 3 months in the mandible before the reconstructive phase. Teeth that did not respond to vitality testing with carbon dioxide received root canal treatment. Teeth with incomplete root canal fillings were retreated endodontically. Severely destructed nonvital teeth received composite resin buildups (Tetric Ceram, Ivoclar Vivadent) using titanium posts (Mooser/Cylinco, Cendres Métaux). Destructed or previously filled vital teeth also received composite resin buildups. The abutment teeth were then prepared to receive SCs or FDPs. The preparation design included a circumferential shoulder with a width of 1 mm, minimum abutment height of 4 mm, taper of 6 to 10 degrees, and minimum ferrule height of 1.5 mm. When abutment height was less than 4 mm, surgical crown lengthening was performed. On vital teeth, the dentin wound was sealed with bonding material (Syntac Classic, Ivoclar Vivadent). Impressions were taken using a polyether material (Permadyne, 3M ESPE). The SCs and FDPs were fabricated in commercial dental laboratories. Both porcelain-fused-to-metal (PFM) and all-ceramic FDPs were made. The all-ceramic SCs were leucite-reinforced glass-ceramic crowns (IPS Empress, Ivoclar Vivadent), while the all-ceramic FDPs contained a zirconia framework (Cercon, DeguDent) that was veneered (Cercon Ceram S, DeguDent). The FDPs were either cemented with glass ionomer (Ketac Cem, 3M ESPE) or a composite resin cement (Panavia 21 TC, Kuraray). Most implant-supported FDPs were screw-retained; very few SCs were cemented.

Following insertion of the FDPs, radiographs of the abutments were taken. After completion of the treatment, patients were either enrolled in a maintenance

Table 1 Types of Teeth and Tooth Abutments

Type of tooth/abutment	No.	Percent of total
Unrestored tooth	202	21.1%
Restored tooth	284	29.7%
PFM SC abutment	249	26.0%
All-ceramic SC abutment	47	4.9%
PFM FDP abutment	147	15.3%
All-ceramic FDP abutment	28	2.9%
Mixed FDP tooth abutment	1	0.1%
Total	958	100.0%

PFM = porcelain-fused-to-metal; SC = single crown; FDP = fixed dental prosthesis.

Table 2 Types of Implant Abutments

Type of implant	No.	Percent of total
SC abutment	37	48.7%
FDP abutment	38	50.0%
Mixed FDP abutment	1	1.3%
Total	76	100.0%

SC = single crown; FDP = fixed dental prosthesis.

care program with a 6-month recall at the Clinic for Fixed and Removable Prosthodontics and Dental Material Science, University of Zurich, Zurich, Switzerland, or referred to private practitioners.

A clinical and radiographic follow-up examination was conducted 54 to 73 months after insertion of the FDPs and SCs by a single examiner. General medical histories were obtained. Patients were asked to report the frequency of dental hygiene sessions and any complications that had occurred since the incorporation of the FDPs. Patients were also asked about their degree of satisfaction with treatment (highly satisfied, satisfied, or not satisfied).

To assess the level of the patient's oral hygiene, the PCR was determined. The degree of inflammation of the periodontal tissues was assessed by BoP. Probing pocket depth (PPD) and probing attachment level were measured using a periodontal probe. Radiographs were taken of all teeth and implants to assess bone levels and to screen for periapical pathologies. The teeth were examined for caries lesions, and vitality testing was performed using carbon dioxide. All FDPs were screened for technical complications, ie, loss of retention, fracture of abutments, fracture of frameworks, chipping of veneering ceramic, and screw loosening at implant-supported FDPs.

At the initiation of this study, no ethical approval for this type of retrospective study design without any interventions was required in Switzerland. The patients agreed to participate in recall visits as a part of the undergraduate student course. The periodontal measurements and radiographs were part of the normal examinations at the 5-year recall appointment.

The collected data were analyzed using descriptive statistics. Survival and complication rates were calculated based on the number of abutments and prostheses available at the follow-up examination.

Results

Of the 52 patients who had been treated, 45 (86.5%) could be recruited for follow-up. Of the 7 patients who could not be examined, 2 had died, 2 were suffering from a medical condition preventing them from participating in the study, and 3 could not be contacted because they had moved and the new address could not be identified.

The mean observation period at follow-up was 5.26 ± 0.47 years (range: 54 to 73 months).

At the follow-up examination, the median age of the patients was 61.3 years (range: 34.3 to 84.0 years). Of the patients examined, 28 (62.2%) were women and 17 (37.8%) were men. Ten (22.2%) patients were smokers, 5 (11.1 %) were suffering from type 2 diabetes, and 24 (53.3%) indicated that they had undergone regular maintenance care including oral hygiene procedures at least once a year. Eighteen (40.0%) patients had also participated in a randomized controlled clinical trial comparing PFM and all-ceramic FDPs.[15] These patients were enrolled in a 6-month recall with dental hygiene procedures at the clinic.

Teeth and Implants

At the end of the active phase of treatment, 958 teeth and 76 implants were present. Two hundred two teeth were natural, unrestored teeth whereas 262 had composite or amalgam restorations or ceramic inlays (Table 1). Two hundred ninety-six teeth were abutments for SCs and 175 teeth were abutments for FDPs. Twenty-two teeth bore preexisting FDPs or SCs that had remained unchanged during the active phase of treatment and were not analyzed as part of this study. Altogether, 471 tooth abutments were analyzed. Of these, 311 (66.0%) were vital and 160 (34.0%) were nonvital.

Table 3 Characteristics of Reconstructions

Type of reconstruction	No. of units									Total no. of reconstructions
	1	2	3	4	5	6	7	10	12	
Tooth-supported										372
PFM SC	249									249
All-ceramic SC	47									47
PFM FDP		1	39	9	9	1	1	1	1	62
All-ceramic FDP			12	2						14
Implant-supported										52
SC	37									37
FDP		2	10	3						15
Mixed FDP			1							1
Total										425

PFM = porcelain-fused-to-metal; SC = single crown; FDP = fixed dental prosthesis.

A total of 76 implants were placed (Table 2), 22 of which were Straumann and 54 Brånemark. Thirty-seven implants served as abutments for SCs and 39 implants were abutment for FDPs.

Prostheses

A total of 425 SCs and FDPs were inserted during the active phase of therapy (Table 3). Two hundred ninety-six SCs and 76 FDPs were tooth-supported, while 37 SCs and 15 FDPs were implant-supported. One single mixed implant and tooth–supported reconstruction was made.

Survival

Teeth and Implants. At the follow-up examination, a total of 953 teeth and 76 implants were still in situ. Five teeth were extracted, representing 0.5% of all teeth present (restored and unrestored) at the end of the active phase of therapy. No implants were lost. Of the 5 teeth lost, 2 were abutment teeth that had been extracted because of root fracture; in one case, the root was removed under an FDP and the prosthesis remained in situ. One abutment tooth was extracted because of endodontic complications; the FDP remained in function. Two teeth not serving as abutments were extracted in one patient as a result of recurrent periodontal disease.

Survival of FDPs. Overall, four FDPs were lost, yielding an overall survival rate of 99.1% (Table 4). Three of these were tooth-supported PFM SCs that were lost because of abutment or root fractures. One five-unit tooth-supported PFM FDP in the maxillary anterior region had to be removed because of loss of retention on one abutment tooth. A new FDP was fabricated but not included in the analysis of this study.

Table 4 Survival of Reconstructions

Type of reconstruction	Surviving	Survival rate
Tooth-supported		
PFM SC	246/249	98.8%
All-ceramic SC	47/47	100.0%
Total SC	293/296	99.0%
PFM FDP	61/62	98.4%
All-ceramic FDP	14/14	100.0%
Total FDP	75/76	98.7%
Implant-supported		
SC	37/37	100.0%
FDP	15/15	100.0%
Mixed FDP	1/1	100.0%
Overall survival rate	421/425	99.1%

PFM = porcelain-fused-to-metal; SC = single crown; FDP = fixed dental prosthesis.

Biologic Conditions

PCR and BoP. The mean PCR at follow-up was 22.8% ± 16.5%; the mean value for BoP reached 21.5% ± 9.9%.

PPD. The mean PPD of all teeth at the follow-up examination was 2.36 ± 1.12 mm. The range of PPDs varied between 1 and 9 mm. PPD < 4 mm was found in 90.1%, PPD 4 to 6 mm in 9.8%, and PPD ≥ 7 mm in 0.1% of sites (Fig 1). Some abutment teeth (6.4%) exhibited recurrent periodontitis, defined as PPD ≥ 5 mm.

Furcation Involvement. At the follow-up examination, 211 molars (including third molars) were examined. Furcation involvement was diagnosed in 65.9% of molars. Class I furcation involvement was present at 54.5% of molars, while Class II was noted in 11.4% and Class III in 0%.

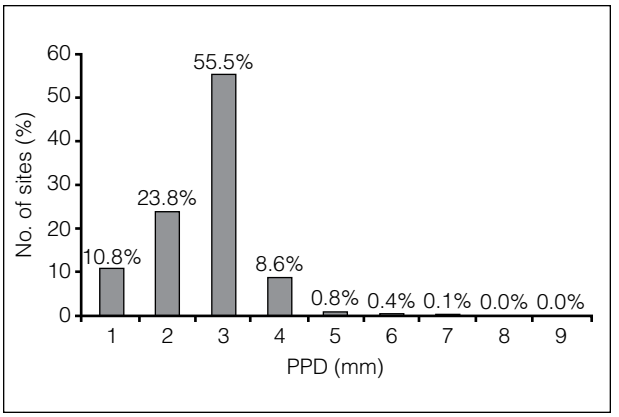

Fig 1 Frequency analysis of PPD at teeth.

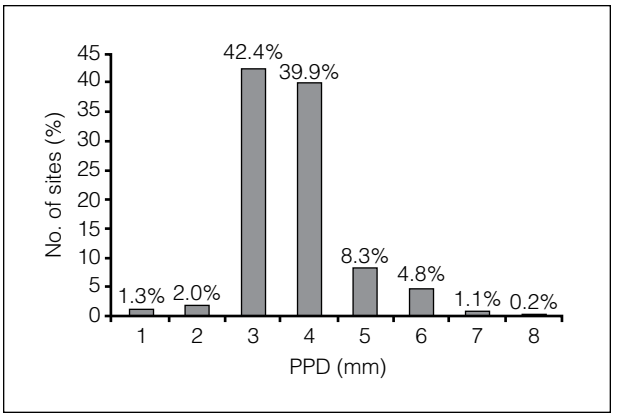

Fig 2 Frequency analysis of PPD at implants.

Caries. In total, seven teeth developed caries (0.7% of all teeth). Two abutment teeth were reconstructed during the active phase of therapy, representing 0.4% of all abutment teeth, and two lesions were found in a preexisting FDP. Three lesions were found in teeth restored with composite resin. No natural unrestored teeth developed caries.

Loss of Vitality and Periapical Pathologies. Nine (2.9%) initially vital abutment teeth reacted negative to vitality testing with carbon dioxide and showed signs of periapical pathology. Eight teeth that had been treated with root canal therapy during the active phase of treatment exhibited periapical pathologies, determined using radiographs. This accounted for 5% of all endodontically treated abutments.

Hard and Soft Tissue Conditions Around Implants. All implants showed clinical and radiographic signs of osseointegration. None of the implants showed marginal bone loss greater than 2 mm.

The mean PPD at implants was 3.72 ± 0.98 mm. PPD < 4 mm was found in 45.7% of sites, PPD 4 to 6 mm in 53.0%, and PPD ≥ 7 mm in 1.3% (Fig 2). Some sites around implants (35.8%) had a positive BoP reaction. No pus was observed, and none of the implants caused pain or discomfort.

Technical Complications

Loss of Retention. Loss of retention occurred in three cases, representing 0.8% of all FDPs and SCs on teeth, or 2.6% of all vital abutments and 0.6% of all nonvital abutments. One case of loss of retention occurred in one of the few full-arch FDPs in the study. This maxillary PFM FDP became loose after 18 months of function and could be recemented successfully. The second loss of retention occurred at an abutment tooth of a five-unit PFM FDP with three abutments in the anterior maxilla. The third loss of retention was an SC that included loss of retention of the post and core. No loss of retention was observed in the few cemented implant-supported SCs.

Abutment and Root Fracture. One vital abutment tooth (0.3% of all vital abutments, 0.2% of all abutments) suffered a horizontal abutment fracture. Four nonvital abutment teeth (2.5% of all nonvital abutments, 0.8% of all abutments) suffered a vertical root fracture; two were abutments of PFM FDPs and two had been restored with SCs.

Material Fractures. No implant or framework fracture occurred. Fracture of the veneering ceramic occurred in 16 FDPs, representing 3.8% of all prostheses. A four-unit implant-supported FDP exhibited ceramic fractures at three units.

Screw Loosening. No loosening of abutment or occlusal screws was observed, and no composite resin filling of the screw access holes failed.

Overview of Complications

The biologic complications in relation to initially vital and nonvital abutment teeth are summarized in Table 5. The technical complications in relation to initially vital and nonvital abutment teeth, implants, and pontics are summarized in Table 6.

Percentage of Patients with Complications. Of the 45 patients, 29 (64.4%) experienced a complication (including patients with complications at nonabutment teeth). Only 35.6% of patients were free of any complications. Many complications (eg, chippings) were not noticed by patients.

Patient Satisfaction

The majority of patients (82.2%) stated that they were highly satisfied with treatment, 15.6% indicated that they were satisfied, and only one patient (2.2%) was not satisfied.

Table 5 Biologic Complications

Abtument type	Caries	Endodontic complication*	Recurrent periodontitis
Vital	0.6%	2.9%	7.1%
Nonvital	0.0%	5.0%	5.0%

*Vital teeth = loss of vitality; nonvital teeth = periapical radiolucency.

Table 6 Technical Complications

Abutment type	Loss of retention	Framework fracture	Veneer fracture	Abutment fracture
Vital	2.6%	0.0%	1.0%	0.3%
Nonvital	0.6%	0.0%	1.3%	2.5%
Implant	0.0%	0.0%	10.5%	0.0%
Pontic	NA	NA	6.1%	0.0%

NA = not applicable.

Discussion

The results of the present study demonstrated high survival and low complication rates of all FDPs. The periodontal condition of the patients was very good, with low PCR and BoP values. In general, there was a tendency for more complications at nonvital abutments. Thus, the most frequent biologic complication was the development of a periapical lesion at endodontically treated abutments. The most frequent technical complication was fracture of veneering ceramics.

The survival and complication rates are to be interpreted with care since there was a high number of FDPs per patient. However, the few complications observed in this study were spread over the patient sample, and no clustering effect occurred. There was also a considerable dropout rate of 13.5%; the fate of these patients' FDPs is not known. Since the patients have an 8-year warranty on reconstructions at the clinic, it can be speculated that healthy dropout patients would have come back to the clinic if they had noted any complications.

Another critical point was that 18 of 45 patients were part of another study. This other study was a randomized controlled clinical trial comparing short-span PFM and zirconia FDPs. Only one three- or four-unit FDP per patient was part of that study; the majority of units were not. Furthermore, both types of FDPs (PFM and zirconia) were part of standard care provided in this course.

The results of this study compare favorably to other studies on tooth- and implant-supported SCs and FDPs. The 5-year survival rate of tooth-supported SCs in this study amounted to 99%. A recent systematic review reported a 95.6% survival rate for SCs.[1] Cohort studies on tooth-supported FDPs revealed 5-year survival rates between 94.5% and 97.5%,[7,16,17] which is slightly lower than the 98.7% found in this study. Although these results are encouraging, it should be kept in mind that longer-term studies report decreasing survival rates over time. A systematic review on tooth-supported FDPs found a 10-year probability of survival of 89.1%.[6] After more than 10 years in service, the survival rate of tooth-supported FDPs seems to decrease progressively, eg, 87% at 12 years in a study on 1,674 FDPs,[16] 68% at 15 years in another FDP study,[18] or 74% at 15 years in a meta-analysis on FDPs.[19]

In recent systematic reviews, 5-year survival rates of 94.5% and 95.0% were noted for implant-supported SCs[1] and implant-supported FDPs,[3] respectively. In the present study, the survival rate for implant-supported SCs and FDPs was 100%.

The BoP and PCR in this study were relatively low (21.5% and 22.8%, respectively), and the periodontal status of the patients was generally good. A study on the maintenance of periodontal attachment levels in prosthetically treated patients showed higher PCR (42% to 48%) and BoP values (28%) than those reported in the present study, and yet, no attachment loss occurred during the observation period of 5 to 17 years. Several studies show that BoP levels above 20% and 30% present higher risk for periodontal breakdown.[20–22] This means that the population in the present study has a low risk for periodontal disease progression.

The caries rate for abutments in systematic reviews on SCs and FDPs ranged from 1.8% to 3.2% for SCs at 5 years[2] and 9.5% for FDP abutments at 10 years.[6] In this study, the caries incidence at abutments was much lower (0.4% of abutment teeth). This might be because only patients who seemed motivated to improve oral hygiene were selected for the student course. In addition, patients received intensive hygiene instructions during the active phase of treatment, and the majority had regular dental hygiene visits after the completion of prosthetic treatment. Other authors also observed low caries rates with a recall interval of 6 months.[17] Another reason for the low caries rate might be the low rate of loss of retention, since this complication is often followed by caries.

Loss of vitality occurred in 2.9% of all vital abutment teeth. A 5-year systematic review on SCs showed a similar value of 2.1%.[2] For FDPs, the rate of loss of vitality seems to be slightly higher. A study on FDPs found that 4.2% of initially vital abutments had become nonvital after 4.5 years,[23] and a 10-year systematic review revealed that 10% of vital abutments

had become nonvital.[6] For the present study population, it remains to be determined how many teeth will lose vitality between 5 and 10 years of observation. In all instances of loss of vitality in the present study, root canal treatment could be carried out by perforating the FDPs; therefore, no FDP was lost because of this complication.

The rate of periapical lesions at endodontically treated teeth in this study was relatively high at 5%. Two recent systematic reviews reported generally higher failure and complication rates for root canal treatment. In these reviews, the survival rate for primarily endodontically treated teeth after 4 to 5 years was 93%,[24] and the success rate for secondary root canal treatment was 76.7%.[25] Survival and complication rates found in this study (including teeth with primary and secondary root canal treatment) are still lower than those reported in systematic reviews.

In this study, no case of peri-implantitis was observed. Other studies reported 9.7% soft tissue complications or peri-implantitis at SCs[1] and 8.6% peri-implantitis and soft tissue complications at FDPs after 5 years.[4] Implants are regarded as successful if bone loss does not exceed 1.5 mm in the first year of function or 0.2 mm annually thereafter.[26,27] No implant in the study suffered more than 2 mm of bone loss. These results compare favorably with marginal bone levels of Straumann and Brånemark implants in other studies.[28]

Loss of retention was rare and noted in only 0.8% of all tooth-supported FDPs, which is lower than that reported in most other studies. A retrospective study on failed FDPs and SCs found that loss of retention was the second most frequent reason for failure, following caries.[29] Recent studies also report higher rates of 2.8% for all-ceramic SCs and 0.7% for PFM SCs after 5 years.[2] For FDPs, loss of retention was reported to occur in 2.3% of reconstructions after 5 years[17] or 3% at 10 years.[30] A systematic review estimated the 10-year risk of loss of retention at FDPs to be 6.4%.[6] There are several factors that may have contributed to the low rate of loss of retention in this study: *(1)* most FDPs were short-span with no or few cantilevers, and it has been demonstrated that the risk of loss of retention increases in FDPs with long pontic spans or with one or more cantilevers[31,32]; *(2)* preparation of the teeth was checked for retentive characteristics (taper of 6% to 10%, minimum abutment height: 4 mm); and *(3)* glass ionomer and composite resin cements were used for cementation.

In the present study, root fracture occurred in 2.5% of all nonvital abutments. Therefore, it was the second most common complication for nonvital abutments. A systematic review calculated a cumulative 5-year rate of root fractures of 0.4% at teeth supporting SCs.[2] A systematic review on FDPs calculated a 10-year risk of root fracture leading to FDP loss of 2.1%.[6] In this study, most nonvital teeth received titanium posts and composite resin buildups. Older studies recommend the use of cast gold posts and buildups. However, a recent study showed similar survival rates for composite resin buildups.[14]

No metal or zirconia framework fracture in tooth- or implant-supported FDPs occurred in this study. Framework fracture in PFM FDPs is reported to be rare[30] or not observed at all.[15] Fracture of zirconia frameworks was reported in four of five studies on zirconia FDPs,[33] but mostly in relation to special factors such as insufficient connector thickness or an accident (biting on a stone).

In contrast to framework fractures, veneering fractures were quite frequent, occurring in 3.8% of all FDPs. Other studies report similar rates of veneering fractures. In a 5-year systematic review, the rate of veneering fracture was 3.7% for all-ceramic SCs and 5.7% for PFM SCs.[2] For implant-supported SCs and FDPs, the reported rate of ceramic fracture was 4.5% for SCs[1,4] and 13.2% for FDPs.[4] Also, in this study, there was a tendency for higher rates of veneering fractures at implant-supported FDPs than at tooth-supported FDPs.

In this study, no screw loosening or screw fracture was observed. Systematic reviews have reported relatively high rates of screw loosening in 5.8% of FDP abutments[4] or 12.7% of SC abutments[1] after 5 years. Screw fracture was reported to be relatively rare (1.5% for FDP abutments[4] and 0.35% for SC abutments).[1]

Patient satisfaction in the present study was very high. Although only 35.5% of patients were free from any complications, 82.2% stated that they were highly satisfied. This is probably because most complications were minor and could be treated without losing the FDP. This also shows that patients with heavily restored dentitions are tolerant of minor complications.

Conclusions

The results of this study demonstrated high survival and low complication rates for both teeth and implants supporting fixed prostheses in a convenience sample of patients selected to undergo comprehensive prosthodontic treatment. This resulted in high patient satisfaction. The periodontal conditions of the patients were very good, with low PCR and BoP values as a result of generally good oral hygiene in this highly motivated patient sample. In general, there was a tendency for more complications at nonvital abutments. Thus, the most frequent biologic

complication was the development of periapical lesions at endodontically treated abutments. The most frequent technical complication was fracture of the veneering ceramic.

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