ACTA ODONTOLOGICA SCANDINAVICA
2023, VOL. 81, NO. 5, 358–362
https://doi.org/10.1080/00016357.2022.2155239

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ORIGINAL ARTICLE

Satisfaction and preferences among patients with both implant-supported single crown and tooth-supported fixed dental prosthesis: a pilot study

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ABSTRACT

Objective: The objective of the study was to assess patient-reported preferences and outcomes in patients rehabilitated with both an implant-supported single crown (ISC) and a tooth-supported fixed dental prosthesis (FDP).

Materials and methods: The electronic journal system at the Faculty of Dentistry, University of Oslo, was searched to find patients presenting both an ISC and an FDP replacing no more than two teeth between abutments. Identified patients that agreed answered a questionnaire followed by a clinical examination. Descriptive statistics was calculated.

Results: Thirty patients were included. The mean function time was 11.8 years for FDPs and 6.6 years for ISCs. All but three patients were satisfied with both rehabilitation modalities. No patients were unsatisfied with aesthetics or function of either rehabilitation. All patients reported satisfactory function of their restorations and reported chewing without problems. The self-reported post-operative complications were few, but less than observed in the clinical examinations.

Conclusions: More patients reported food impaction with their FDP as compared to their ISC. Function and aesthetics of FDPs and ISCs were rated similarly, but more patients found the ISC treatment more uncomfortable. Despite this finding, most patients would prefer to undergo ISC treatment if they were to replace another missing tooth.

ARTICLE HISTORY
Received 8 September 2022
Revised 29 November 2022
Accepted 1 December 2022

KEYWORDS
Patient-reported data; dental implants; cross-sectional study; fixed dental prosthesis; patient satisfaction

Introduction

Tooth loss is associated with reduced oral health-related quality of life [1] and several treatment options are available to replace missing teeth to restore function and aesthetics. For single tooth replacement, an implant-supported single crown (ISC) or a tooth supported fixed dental prosthesis (FDP) are common treatment modalities. Both options have demonstrated similar survival rates at 5-, 10- and 15-year follow-up [2,3]. Furthermore, technical and biological complications have also been reported for both treatment modalities [2–4]. The most frequent biological complications for FDPs were loss of abutment vitality, dental caries and periodontitis with cumulative 5-year complication rates at 6.1%, 4.8% and 0.4%, respectively. The highest complication rate for ISCs was due to soft tissue complications (8.6%). As for technical complications, the highest complication rates were recorded for loss of retention (3.3%) and material fractures (1.6%) for FDPs. For ISCs, the highest complication rates have been reported for porcelain fracture (4.5%) and loosening of abutment or occlusal screw (12.7%) [2].

Often, the clinical presentation dictates which of the two fixed rehabilitation modalities are preferable. Preparation for fixed tooth-supported prosthesis may remove up to 70% of the coronal tooth structure, and risk of pulp necrosis has been reported at 30% after 10 years [5–7]. To avoid removal of healthy tooth substance and risk of endodontic complications [8], clinicians may be reluctant to prepare intact teeth for FDPs and instead consider implant placement [9]. On the contrary, if neighbouring teeth already have significant restorations, an FDP may be preferable for improvement of existing restorations and avoid the surgical trauma required for implant rehabilitation [10]. The initial economic burden has been reported similar for FDPs and implants; however, the cost-effectiveness over 20 years was estimated to be in favour of implant treatment [3,11]. One obvious difference between the two treatment modalities is the time span from start of treatment to delivery of the restoration. Brägger et al. reported a mean treatment time of 3.2 months for FDPs and 5.9 months for implants [12]. The same authors also reported a significantly higher number of visits for fabrication of implants (8.1 visits) as compared to FDP (4.8 visits), but similar chair-time for both modalities.

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In some situations, both treatment modalities may be considered and consequently the patient preference should be further emphasized. The patient's knowledge of the different treatment strategies plays a major role for their preference. Al-Quran et al. found that 60% of patients had good knowledge about FDPs and 57% about implants. Among patients who had FDPs, 34% had no knowledge of dental implant therapy [13]. The patients' awareness and expectations have been found to have significant effect on the choice of treatment [13]. As both modalities are regarded similar in terms of survival and complication rates, patient-reported data may be useful to guide patients and clinicians.

Studies have shown high patient satisfaction for both ISC and FDP [14,15]. Furthermore, improvement of oral-health-related quality of life has been reported to be similar in patients who have undergone single ISC or a three-unit FDP for single missing tooth replacement [16]. However, to the best of the authors' knowledge, patient satisfaction evaluated by patients who have undergone both treatments has not been reported previously. Patients who have undergone both treatments are in a unique position to evaluate and compare the treatment modalities.

Therefore, the aim of this pilot study was to assess preferences and patient-reported outcomes in a historical cohort of patients who had undergone both FDP and ISC rehabilitation. The null hypothesis was no difference between patient preference for ISC or FDP.

Materials and methods

The study protocol was approved by the Regional Ethics Committee (REK 165605/2020) and Norwegian Centre for Research Data. The present study was reported according to the STROBE guidelines for cross-sectional studies. Inclusion criteria were patients 20 years or older, presenting with at least one FDP replacing at most two missing teeth between abutment teeth and in addition at least one single ISC. Both replacements had to be in function for at least one year. The patients had to be able to communicate with the examiners, be able to fill out the questionnaire form and be competent to give consent.

All patient journals at the Faculty of Dentistry, University of Oslo, with a dental implant record were identified by electronic searches. Thereafter, journals and radiographs were manually screened to find patients with an ISC and an FDP replacing a single or maximum two teeth. Following review of the inclusion criteria, eligible patients were invited to participate in the study. Candidate patients were contacted by phone, informed about the study and invited to participate. The recruitment period was from February to November 2021.

Prior to answering the questionnaire, the patients were asked to evaluate one designated FDP and ISC. If more than one FDP or ISC met the inclusion criteria, the examiner assigned the restorations with the most similar time in function and/or position in the mouth.

A three-part questionnaire was developed by the authors based on questions from previous surveys assessing outcomes of dental implant therapy [15,17]. It was evaluated by two researchers in the field not involved in the study, tested on three patients, and modified according to the feedback. The first component considered outcomes of the FDP, the second component the outcomes of the ISC, and in the third component the patients were asked to make direct comparisons between the two treatment modalities. The questions included dimensions related to patient satisfaction, perceived function, hygiene measures, cost–benefit and complications. Patients were asked to only consider the designated FDP and ISC, in case of multiple restorations.

After completing the questionnaire, all patients underwent a clinical examination by a certified specialist in periodontology to register reason for tooth loss, years in function of restorations, periodontal diagnosis, dichotomous plaque score (PI) [18], periodontal pocket depth (PPD), bleeding on probing (BoP), technical complications and occlusal relationship. Radiographs were obtained of both the ISC and the FDP. Periodontal and peri-implant diagnoses were based on the 2017 World Workshop on the Classification of Periodontal and Peri-implant Diseases and Conditions [19,20].

Descriptive statistics with means and standard deviations, and frequency distributions, are presented.

Results

A flowchart of the study patients is provided in Figure 1. Thirty-two patients answered the questionnaire and were examined, of which two patients were excluded due to missing an FDP at the time of examination. Of the patients, 20 were male (67%) and 10 female (33%). The mean age of the patients was 65 years (range: 31–96). The mean year in function for the FDPs was 11.8 years (range: 1–34) and 6.6 years (range: 1–25) for the ISCs. Four patients received the FDP and ISC in the same rehabilitation, five patients received the ISC treatment some time before the FDP, and 21 patients got the FDPs prior to the ISC.

The distribution of replies in the questionnaire is provided in Table 1. The majority of the patients were satisfied or very satisfied with both rehabilitations, except for three patients who were very unsatisfied with their ISC only. No patients were unsatisfied with the aesthetics or function of either

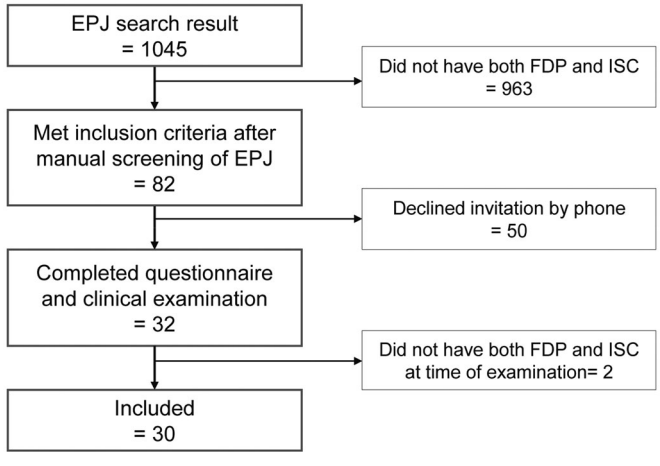

Figure 1. Flowchart of the patient recruitment.

Table 1. Distribution of questionnaire replies.

Questions about FDP or ISC						
		Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
How satisfied are you with the treatment	FDP	0	0	1	14	15
	ISC	3	0	0	9	18
			Strongly agree	Agree somewhat	Disagree	Missing
The restoration is aesthetically pleasing	FDP		23	7	0	0
	ISC		27	2	0	1
The restoration functions well for chewing	FDP		27	3	0	0
	ISC		29	1	0	0
The restoration is easy to clean	FDP		19	10	1	0
	ISC		23	6	1	0
There is more food impaction around the restoration as compared to natural teeth	FDP		7	13	10	0
	ISC		2	8	20	0
The treatment was worth the cost	FDP		26	4	0	0
	ISC		21	9	0	0
The treatment outcome fulfilled my expectations	FDP		26	4	0	0
	ISC		26	2	0	2
The treatment procedures involved great discomfort	FDP		1	11	17	1
	ISC		5	9	16	0
				No	Yes	Missing
I have experienced complications following treatment	FDP			30	0	0
	ISC			27	2	1
			0–1	2–3	>3	Missing
If yes, how many visits were required to treat the complications	FDP		0	0	0	30
	ISC		2	0	0	28
			No	Yes		Missing
I would undergo the same treatment again	FDP		3	26		1
	ISC		1	27		2
Comparative questions						
			FDP	ISC	No difference	Missing
Which restoration is easier to clean?			1	10	19	
Around which restoration do you experience more problems with food impaction?			10	2	18	
Which restoration feels more natural to chew with?			3	3	24	
Which restoration do you find the most aesthetic?			3	7	20	
Which treatment procedure was the most uncomfortable to undergo?			6	11	13	
If you were to lose another tooth, which treatment modality would you prefer?			8	18		4

rehabilitation. All patients reported good function of their restorations and reported chewing without problems. For both FDPs and ISCs, only one patient disagreed that the restoration was easy to clean, and 20 persons agreed either strongly or partly that the FDPs had more food impaction compared to natural teeth, as compared to only 10 in the ISC group. No patients disagreed that the restoration was worth the price they paid or that the treatment fulfilled their expectations. Five patients strongly agreed the ISC treatment procedure involved great discomfort, as compared to only one for the FDPs. No patients reported complications following FDP treatment, whereas two patients reported complications for ISC. Despite the reported complications, both patients were very satisfied with the ISC treatment. When asked if they would undergo the same treatment again, three patients replied no to FDP treatment and one to ISC treatment.

For the comparative part of the questionnaire, 10 patients reported their ISC easier to clean. Only one considered the FDP easier to clean and 19 reported no difference. A similar pattern was seen when patients were asked which modality was associated with more food impaction. More patients found the ISC more aesthetic as compared to the FDP (7 vs. 3); however, 20 reported no difference. More patients found the ISC treatment procedure more uncomfortable as compared to FDP (12 vs. 6). Finally, when asked which treatment modality they would prefer if another tooth was lost, provided a binary choice between ISC and FDP, 18 would choose an ISC, whereas eight would choose an FDP. Four patients could not make the decision.

Table 2. Reason for missing tooth.

Reason for missing tooth	FDP	ISC
Caries	12	9
Periodontitis	7	8
Endodontic complication	2	5
Congenital	3	4
Fracture	1	2
Trauma	3	0
Other/can't remember	2	2

Reason for missing teeth is reported in Table 2. Of the patients, 24 had FDPs with one pontic and six patients had two pontics. One patient was diagnosed with periodontal

Table 3. Measurements of plaque index (PI), bleeding on probing (BoP) and periodontal pocket depths (PPD).

	PI (%)		PPD (mm)		BoP (%)	
	Mean	SD	Mean	SD	Mean	SD
Full mouth	31.3	25.4	2.7	0.4	24.6	16
FDP (abutment site level)	29.4	29.4	2.9	0.8	40.3	30.4
ISC (implant site level)	14.4	24.3	3.5	1.4	37.2	32.1

Mean and standard deviation (SD) presented.

health, three with gingivitis and 26 with periodontitis. Three of the periodontitis—patients were stable cases of periodontal health (BoP $<10\%$ and no site ≥ 4 mm + BoP). Of the implants evaluated, six presented peri-implant health, 23 peri-implant mucositis and one with peri-implantitis. Measurements of plaque index, BoP and PPDs are provided in Table 3. All 30 FDPs and 26 of the ISCs had occlusal contact. Technical and biological complications recorded at the clinical examination revealed one caries lesion in an FDP abutment tooth, two were endodontically treated through the restoration and four had porcelain fracture. Two ISCs had porcelain fracture and one had a loose occlusal screw.

Discussion

This pilot study demonstrated high patient satisfaction for both FDP and ISC treatment among patients who have experienced both treatment modalities. The patients were satisfied with function and cost–benefit of their restorations. Few patients reported post-operative complications following treatment, but a higher number of technical and biological complications were found in the clinical examination. Most patients found their restorations easy to clean, but more patients reported food impaction with their FDP as compared to their ISC. In direct comparison, function and aesthetics of FDPs and ISCs were rated similarly, but more patients found the ISC treatment more uncomfortable. Despite this finding, most patients would prefer to undergo ISC treatment if they were to replace another missing tooth.

Previous studies evaluating patient-reported outcomes have applied different evaluation methods in different populations, but in general a high satisfaction of both treatment modalities have been reported. Derks et al. reported 94% of patients were satisfied with their implant-supported restoration and Pjetursson et al. reported that 92% of patients found that the implant treatment satisfied their expectations [15,17]. A study by Håff et al. used a visual analogue scale to evaluate patient satisfaction following FDP treatment and found a mean value of 9.3 out of 10.0 [14]. Albeit a much smaller population in the present study, the findings corroborate existing literature with 97% of the population being satisfied or very satisfied with their FDP and 90% with their ISC. The particularity of the present population was the presence of both ISC and FDP in the same patients. Interestingly, the satisfaction was similar for both treatment modalities, but more patients would prefer ISC treatment for a future replacement of missing teeth if needed. The preference for ISC over FDP treatment, even though both treatment outcomes were highly rated with respect to satisfaction, was an interesting finding which should be further investigated.

Although the patients reported high satisfaction, the clinical findings revealed complications to be common for both treatment modalities and higher than what was self-reported. The cumulative number is most likely higher as the complications found in the clinical examinations do not account for previous complications which may have been treated already and therefore not visible at the time of examination. Simonis et al. reported rates of 31.25% for mechanical complications for ISCs and 16.94% of the implants had peri-implantitis following an evaluation period of 10–16 years [21]. Although FDPs were not evaluated, the authors also found high patient satisfaction following implant treatment. Self-reported complications were not assessed by Simonis et al. Discrepancies between patients' subjective assessments and clinician's evaluations may be expected [22]. The findings further highlights the importance of subjective measures, also when defining success criteria [23].

Most patients ($n = 20$) reported more food impaction for their FDPs as compared to natural teeth ($n = 10$). Only one patient disagreed that both the FDP and ISC restoration was easy to clean. As an FDP consists of two abutment teeth connected through a pontic and thereby constitutes a larger volume and total surface area as compared to an ISC with two adjacent natural teeth, this finding is rational. Furthermore, an FDP has interproximal spaces inaccessible for the use of dental floss, which may be the preferred interproximal hygiene device for some patients. This is reflected by a lower plaque score for ISCs (14.4%) as compared to FDP abutment teeth (31.3%). However, the mean plaque scores for abutment teeth were similar to the full mouth plaque score (29.4%). Both PPD and BoP scores were higher for FDPs (2.9 mm and 40.3%) and ISCs (3.5 mm and 37.2%) as compared to the full mouth scores at 2.7 mm and 24.6%, respectively. Interestingly, despite patients finding the ISCs easier to clean, confirmed by a clinically lower plaque score around implants, 23 implants (76%) were diagnosed with peri-implant mucositis. This finding is higher than previously reported prevalences which range from 19 to 65% [24].

A limitation of this study was the low number of participants. Only 82 out of 1045 screened patients with dental implants met the inclusion criteria, of which 32 accepted to participate. This highlights that patients with both treatment modalities are uncommon. Importantly, recruitment and examination of patients were done during times of COVID restrictions. The mean age of the participants was 65 years, and therefore many candidates were defined as a risk group and therefore reluctant to participate. A larger group of patients would provide further and more precise comparison between the two groups. Another limitation is the heterogeneity of the included restorations and treatment protocols. The treatment protocols were not standardized, as some of the patients had their FDP and/or ISC treatment at private clinics, while others were treated at the university clinic with several different dentists and dental students involved. This was not further explored, as the scope of this investigation was the patient-reported outcomes. The inclusion criteria also included only patients with an FDP and an ISC at the time of examination, and therefore two participants were

excluded. Consequently, the opinions and clinical outcomes of patients with failed restorations were not accounted for. It may be speculated that patients would report in disfavour of the failed restoration. Hence, the presented overall patient satisfaction data may be overly positive as compared to a general population which includes restoration failures. The questionnaire used is also a limitation. Although questionnaires have been developed and used for patients with ISCs and FDPs separately in the past, this is, to the best of the authors' knowledge, the first questionnaire in a population with both forms of restorations. Therefore, the validation of the questionnaire was limited, and reliability has not been tested.

In conclusion, and within the limitations of the study, high patient satisfaction was reported for both FDP and ISC treatment among patients rehabilitated with both treatment modalities. Function and aesthetics of FDPs and ISCs were rated similarly, but more patients found the ISC treatment procedure uncomfortable. Despite this finding, most patients would prefer to undergo ISC treatment if they were to replace another missing tooth.

Disclosure statement

The authors declare no conflicts of interest related to this study.

Funding

This study was self-funded by the authors and their institutions.

Notes on contributor

Minh K. L. Thieu: methodology, formal analysis, investigation, data curation, writing – original draft, writing – review and editing, and visualization. Erik K. Mauland: conceptualization, methodology, investigation, writing – original draft, and writing – review and editing. Anders Verket: conceptualization, methodology, investigation, writing – original draft, writing – review and editing, supervision, and project administration.

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Data availability statement

The data from this study are available from the corresponding author upon reasonable request.

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