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Association between the treatment choice of implant-supported fixed partial dentures and oral health-related quality of life in patients with a shortened dental arch: A preliminary observational study

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Abstract *Background/purpose:* In cases of missing posterior teeth, treatment modalities based on the shortened dental arch (SDA) concept may be a viable alternative. However, the association between oral health-related quality of life (OHRQoL) and patients' treatment decisions remains unclear. This study aimed to investigate the association between OHRQoL and the decision to be treated with implant-supported fixed partial dentures (IFPDs) or take a wait-and-see approach in patients with an SDA missing a single second molar and to clarify the impact of IFPD treatment on the OHRQoL.

Materials and methods: The Oral Health Impact Profile (OHIP) questionnaire was administered twice (pre- and post-treatment) and once to 41 patients with a unilateral SDA missing a single second molar who chose IFPD treatment (IFPD group, n = 22) and the wait-and-see approach (no treatment group, n = 19), respectively. Logistic regression analysis was performed with IFPD treatment choice as the objective variable and the four OHIP dimension scores, age, and sex as covariates. The pre- and post-treatment values of the OHIP summary and four-dimension scores were compared using a paired *t*-test.

Results: The IFPD treatment choice was significantly associated with sex (male), higher *Oral Function* dimension scores, and lower *Psychosocial Impact* dimension scores (all $P < 0.05$). The OHIP summary and four-dimension scores were significantly lower following IFPD treatment (all $P < 0.05$).

Conclusion: IFPD treatment for a single missing second molar may be clinically beneficial for improving the OHRQoL of patients with an SDA who experience a decline in masticatory function.

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Introduction

The loss of natural teeth is one of the major public health issues that may affect an individual's oral health-related quality of life (OHRQoL).[1] Permanent teeth that are usually extracted early because of dental problems such as caries are the first and second molars.[2]

In cases of missing posterior molars, treatment strategies based on the shortened dental arch (SDA) concept may be a viable alternative to conventional prosthodontic treatment.[3] The SDA concept was reported by Käyser in 1981[4] and is now widely accepted among dental professionals and researchers. It states that adequate oral function can be maintained if at least four occlusal units (one and two occlusal units corresponding to a pair of occluding premolars and molars, respectively) are present.

When comparing the SDA approach with prosthetic interventions, such as removable partial denture (RPD) treatment, it has been reported that there is no difference in OHRQoL over 10 years,[5–7] indicating that the wait-and-see approach of an SDA is likely to maintain acceptable OHRQoL in the long term. Hence, it is recommended that SDA treatment options should be considered as the first choice in terms of OHRQoL.[7] However, it has been reported that chewing ability may be impaired with only four occluding pairs of premolars, thus requiring one or more additional occluding pairs of molars.[8] Moreover, the impaired OHRQoL level in SDA cases may differ depending on the presence of the first molars.[9] There is an obvious risk of eruption of opposing teeth in SDA cases,[10] and it has been suggested, although controversially,[11] that there is an increased risk of developing temporomandibular disorders.[12]

Although some studies have argued against the SDA concept in the last decade,[9] it has been demonstrated that an SDA with only missing second molars did not show a significant OHRQoL impairment.[8] Therefore, the SDA concept is widely used in clinical practice. Patients with an SDA who choose implant-supported fixed partial dentures (IFPDs) treatment may have a more impaired OHRQoL than those who choose a wait-and-see approach; however, this is unclear owing to a lack of evidence. Furthermore, the extent to which IFPD treatment affects OHRQoL in SDA cases with a single missing second molar is unclear.

This study investigated the association between OHRQoL impairment and the decision-making regarding whether to be treated with IFPDs or take a wait-and-see approach in patients with a unilateral SDA missing a single second molar and to clarify the effect of IFPD treatment on the OHRQoL. The null hypothesis was that there was no association between OHRQoL impairment and the decision to receive IFPD treatment.

Materials and methods

Patients

Patients were consecutively recruited at a university hospital (Tokyo, Japan) and a private clinic (Saitama, Japan) between April 2021 and April 2023. Patients aged $\geq$20 years with an SDA, who had unilateral missing second molars in either the maxilla or mandible and were willing to receive IFPD treatment or take a wait-and-see approach (no treatment), were included. The exclusion criteria are presented in Table 1. The time elapsed since tooth extraction was not considered. The study protocol was approved by the institutional ethics committee (22-203-A) and was conducted in accordance with the Declaration of Helsinki. All the patients provided written informed consent before participating in the study.

Data collection

After a thorough explanation of the possible treatment options by the attending dentists, the patients consulted with the dentists and selected a treatment plan. Patients who were willing to be treated with IFPDs for missing second molars were grouped in the IFPD group, and those who were willing to be followed up were grouped in the no-treatment (NT) group.

Demographic (age and sex) and intraoral data were recorded after patient enrollment. To objectively evaluate the masticatory function, the masticatory

Table 1 Exclusion criteria.

(1) Missing teeth that had not been restored with fixed prostheses except for the missing second molar
(2) An erupted third molar posterior to the missing second molar
(3) Using removable partial dentures
(4) Seeking dental treatment other than treatment with implant-supported fixed partial dentures, such as cantilever bridge use, for the missing second molar
(5) Pain in the orofacial region
(6) Difficulty answering self-administered questionnaires

performance was assessed using the gummy jelly method, and the occlusal force was measured. Regarding masticatory performance, the patients were asked to chew a standardized gummy jelly (Glucolumn; GC Corp., Tokyo, Japan) with 10 mL water for 20 s and spit it out through a dedicated filter into a cup. The glucose concentration of the filtrate containing glucose eluted from gummy jelly, which is considered the masticatory performance, was measured using a dedicated glucose meter based on the glucose oxidase reaction (Gluco Sensor GS-II; GC Corp.).[13] Regarding the occlusal force, after an arched pressure-sensitive film (Dental Prescale II; GC Corp.) was positioned to cover the entire patient's dentition, the patient was asked to perform maximum clenching at the intercuspal position for 3 s. The occlusal force was measured twice. The interval between the two measurements was a 3-min rest period. The second measurement was conducted after ensuring that the participants indicated that they were no longer fatigued. The films were scanned using a flatbed scanner (GT-X830; Seiko Epson Corp., Nagano, Japan) and evaluated using dedicated software (Bite Force Analyzer; GC Corp.). The mean value of the two measurements was calculated as the occlusal force.[14] After the examination, the patients received an explanation of the questionnaires from the researchers (T.Y. and H.W.) and answered the questionnaires. In the original questionnaire, patients were asked to voluntarily provide their academic history and answer questions regarding items on a 4-point scale for self-rated financial leeway, self-rated understanding of IFPD treatment, and degree of fear of invasive dental surgery.

OHRQoL questionnaire

The OHRQoL was evaluated using the Japanese version of the Oral Health Impact Profile (OHIP-J).[15] The OHIP is a psychometrically sophisticated summary measure of perceived oral health and has been the most widely used in Japan and internationally. The OHIP-J comprises 49 items translated from the original English version of OHIP-49 and five additional items specific to the Japanese population. For each OHIP item, patients were asked to report the frequency of oral problems they experienced in the last month. Responses were graded on a 5-point Likert scale, where 0 represented never, and 4 represented very often. To permit international comparisons, the OHIP summary score for the original 49 items (score range: 0–196) was calculated.[16] A lower OHIP summary score indicated better OHRQoL. In addition to the OHIP summary score, four-dimension (*Oral Function* [10 items], *Orofacial Appearance* [6 items], *Orofacial Pain* [7 items], and *Psychosocial Impact* [18 items]) scores[17,18] that represent the following aspects of oral health were calculated. If any of the OHIP item scores were missing, they were imputed using the median of the non-missing values for the patient; however, data with five or more missing answers were excluded from the analysis.[17]

The OHIP was evaluated once in the NT group and twice in the IFPD group: before implant surgery (pre-treatment) and 1 month after placement of the final superstructure (post-treatment).

Statistical analyses

Demographic data, OHIP scores, masticatory performance, occlusal force, and items from the original questionnaire were compared between the IFPD and NT groups using the Student's t-test or chi-square test.

To analyze the association between OHRQoL impairment and the decision to receive IFPD treatment or not, logistic regression analysis was performed using IFPD treatment choice (IFPD coded as 1 and NT as 0) as the outcome variable and six covariates, including four explanatory variables for the OHIP dimension (*Oral Function*, *Orofacial Appearance*, *Orofacial Pain*, and *Psychosocial Impact*) scores and two confounding factors of age and sex.

The pre- and post-treatment values for the OHIP summary and four-dimension scores in the IFPD group were compared using a paired *t*-test. All statistical analyses were performed using the JMP Pro 16.0 software package (JMP Statistical Discovery LLC, Cary, NC, USA), with a significance level of 0.05.

Results

Forty-one patients (IFPD group: 22; NT group: 19) were included in this study. Twenty-seven patients were from the university hospital, and 14 were from the private clinic. Although the OHIP summary and four-dimension scores were not significantly different between the IFPD and NT groups, the IFPD group tended to have higher OHIP values, indicating lower OHRQoL than the NT group (Table 2). A comparison of the original questionnaire items based on voluntary responses is presented in Table 3.

The results of the logistic regression are presented in Table 4. Significant associations were found between the IFPD treatment choice and sex (male), higher *Oral Function* dimension scores, and lower *Psychosocial Impact* dimension scores.

In the IFPD group, 17 patients completed the IFPD treatment and had a post-treatment OHIP score. No implant loss was observed during the study period. The pre- and post-treatment values are presented in Table 5. The post-treatment OHIP summary and four-dimension scores were significantly lower than the pre-treatment scores.

Discussion

This study analyzed the association between the decision to be treated with IFPDs and OHRQoL, as measured by the OHIP, in SDA patients with a single missing second molar. The results showed that the OHIP *Oral Function* and *Psychosocial Impact* dimension scores were associated with the decision to receive IFPD treatment. Specifically, those who perceived greater dysfunction but less psychosocial impact with respect to their oral condition were more likely to receive IFPD treatment, with the likelihood increasing 1.67-fold with a 1-point increase in the *Oral Function* dimension score and 1.23-fold with a 1-point decrease in the *Psychosocial Impact* dimension score.

This study limited the target cases to those with a single missing second molar, described as "slightly SDA." [12] A

Table 2 Patient characteristics and the results of the OHIP scores and objective masticatory function.

	IFPD group (n = 22)	NT group (n = 19)	*P*-value
Patient characteristics			
Age (years)	56.68 ± 9.65	59.32 ± 13.38	0.469[a]
Sex (n)			
Male	12 (55 %)	6 (32 %)	0.137[b]
Female	10 (45 %)	13 (68 %)	
OHIP scores			
OHIP summary score (0–196)	29.00 ± 21.78	25.37 ± 20.61	0.588[a]
Oral Function (0–40)	6.50 ± 4.75	4.11 ± 4.12	0.095[a]
Orofacial Appearance (0–24)	3.09 ± 2.83	2.79 ± 3.52	0.763[a]
Orofacial Pain (0–28)	5.18 ± 4.07	5.05 ± 4.84	0.926[a]
Psychosocial Impact (0–72)	8.00 ± 8.58	7.32 ± 7.71	0.791[a]
Objective masticatory function			
Masticatory performance (mg/dL)	290.28 ± 89.89	252.11 ± 86.72	0.197[a]
Occlusal force (N)	894.21 ± 478.71	827.39 ± 447.38	0.662[a]

Data are presented as the mean ± standard deviation. [a] Student's t-test. [b] Chi-square test. IFPD, implant-supported fixed partial denture; NT, no treatment; OHIP, Oral Health Impact Profile.

Japanese multicenter study showed that patients with an SDA who lost only the occlusal contacts of their second molars maintained a significantly better OHRQoL than those who lost further occlusal contacts.[8] This evidence supports the clinical decision that a wait-and-see approach should generally be applied to SDA patients with a single missing second molar. Fueki et al. investigated whether patients with various SDA patterns selected prosthetic treatment interventions, including RPD and IFPD use.[19] They reported that only 3.3 % of SDA patients with missing second molars sought IFPD treatment and that the more dissatisfied they were with mastication, the more they desired prosthetic treatment interventions, which aligns with the current study results. Regarding objective masticatory function,

Table 3 Results of the original questionnaire.

	IFPD group	NT group	*P*-value (Chi-square test)
Academic history	n = 18	n = 18	
University, senior college, or graduate school	11 (61 %)	6 (33 %)	0.095
Others[†]	7 (39 %)	12 (67 %)	
Self-rated financial leeway	n = 17	n = 17	
Enough/moderate	15 (88 %)	11 (65 %)	0.106
Limited/little	2 (12 %)	6 (35 %)	
Self-rated understanding of IFPD treatment	n = 17	n = 15	
Sufficient/good	16 (94 %)	5 (33 %)	<0.001*
Below average/little	1 (6 %)	10 (67 %)	
Degree of fear of invasive dental surgery	n = 17	n = 15	
Small/little	7 (41 %)	2 (13 %)	0.080
Great/moderate	10 (59 %)	13 (87 %)	

The number of respondents varied because the responses were voluntary. † Junior high school, high school, vocational school, or two-year junior college. *$P < 0.05$. IFPD, implant-supported fixed partial denture; NT, no treatment.

Table 4 Results of the logistic regression analysis.

	Coefficient	SE	OR	95 % CI	*P*-value
Age	−0.02	0.04	0.98	−0.09 to 0.05	0.563
Sex [Female]	−0.77	0.41	4.67	−1.66 to −0.01	0.048*
Oral Function	0.51	0.21	1.67	0.17 to 1.02	0.002*
Orofacial Appearance	0.08	0.17	1.08	−0.26 to 0.43	0.633
Orofacial Pain	−0.14	0.14	0.87	−0.45 to 0.12	0.304
Psychosocial Impact	−0.21	0.11	0.81	−0.46 to −0.02	0.030*

Regression model: $R^2 = 0.23$, $P = 0.043$. The outcome variable was the choice of implant-supported fixed partial denture (IFPD) treatment (IFPD was coded as 1 and no treatment as 0). *$P < 0.05$. SE, standard error; OR, odds ratio; CI, confidence interval.

Table 5 Pre- and post-treatment comparison results in the IFPD group.

	Pre-treatment	Post-treatment	*P*-value (Paired *t*-test)
OHIP summary score (0–196)	30.00 ± 23.40	16.60 ± 18.26	0.001*
Oral Function (0–40)	6.13 ± 4.76	2.93 ± 3.66	<0.001*
Orofacial Appearance (0–24)	2.60 ± 2.82	1.20 ± 1.64	0.014*
Orofacial Pain (0–28)	5.07 ± 4.20	2.80 ± 3.15	0.001*
Psychosocial Impact (0–72)	6.93 ± 7.90	4.00 ± 5.87	0.015*

Data are presented as the mean ± standard deviation. *$P < 0.05$. IFPD, implant-supported fixed partial denture; OHIP, Oral Health Impact Profile.

there were no significant differences in the masticatory performance and occlusal force between the IFPD and NT groups in this study. This finding might suggest that patient-reported outcome measures, such as the OHIP *Oral Function* dimension scores, could capture the differences that could not be captured by objective outcome measures.[20] However, further studies that include these objective measurement variables as predictor variables are needed to confirm this hypothesis.

In contrast, the *Psychosocial Impact* dimension scores were significantly associated with the choice of IFPD treatment but were inversely associated with the *Oral Function* dimension score. In this study, patients completed the OHIP and original questionnaires after receiving a thorough explanation of the possible treatment options. John et al. stated that OHRQoL impairment in the *Psychosocial Impact* dimension may be caused by having functional, painful, or aesthetic problems, or even in the absence of these direct effects, it may be caused by an accumulation of concern or worry about the current oral condition.[21] Since the IFPD group in this study had a significantly deeper self-rated understanding of IFPD treatment than the NT group (Table 3), it is reasonable to assume that those who fully understood the explanation of IFPD treatment and had reduced psychological stress and anxiety about the treatment and their oral condition tended to choose IFPD treatment.

Regarding the pre- and post-treatment comparison, the OHIP summary and four-dimension scores significantly improved following IFPD treatment. The mean reduction in the OHIP summary scores was 13.4 (standard deviation 13.0) points. Previous studies including various SDA patterns have reported post-treatment improvements in the OHIP-49 summary score of approximately 10–30 points for RPD treatment and approximately 20 points for cantilever bridge treatment.[5,22,23] Regarding IFPD treatment, direct comparisons are not possible because this is the first study to prospectively investigate the effect of IFPD treatment for a single missing tooth in patients with an SDA. However, our results generally agree with those of a previous study that reported that IFPD treatment for a single missing tooth in patients without an SDA improved the OHIP-49 summary score by approximately 10 points.[24] Additionally, it is important to determine whether the treatment effect exceeds the minimally important difference (MID) with regard to the improvement in the OHIP summary score. A previous prospective study has advocated an MID of 6 points on the OHIP summary score with prosthetic treatment.[25] In this study, a substantial improvement of 13 points exceeding the MID was observed, suggesting that replacing missing second molars with IFPDs is clinically beneficial for improving the OHRQoL in patients with a perceived decline in masticatory function.

This study had some limitations that warrant consideration. First, we included patients with an SDA who were willing to receive treatment with IFPDs or undergo follow-up but did not include those who sought other prosthetic treatments. Because it is rare to provide RPDs or cantilever bridges for a single missing second molar, it was anticipated that it would be difficult to recruit such patients; therefore, this study exclusively investigated the two specified groups. Second, the number of patients in the NT group was relatively small. Therefore, the number of covariates entered into the logistic regression analysis was high relative to the sample size. Based on the number of covariates and the proportion of IFPD cases, the required number of patients was estimated at 100, greater than the number of patients we could recruit in this study. Furthermore, socioeconomic factors were not included in the regression model, which may have reduced the generalizability of the results. For these reasons, this study should be regarded as a preliminary one exploring potential factors that may influence patients' treatment decisions. After a preliminary study such as this identifies associations, a confirmatory study should be conducted. Third, we obtained the OHIP score only once from the NT group; therefore, follow-up data were unavailable. To evaluate the direct effect of IFPD treatment on OHRQoL, the IFPD group underwent a post-treatment evaluation one month after their treatment, because OHIP can assess OHRQoL in the most recent month. Several previous studies have followed up patients with an SDA for >10 years and compared the changes in the OHIP scores between RPD treatment and the SDA approach.[5,6] These studies generally found a certain amount of fluctuation in the OHIP score in both the treatment and SDA groups over time. Long-term follow-up allows for a better understanding of the effects of the treatment intervention, accounting for the time effect. Future studies with a larger number of patients and longer follow-up periods are warranted.

Despite the abovementioned limitations, this is the first study to prospectively investigate the OHRQoL in association with the treatment decision of whether to receive IFPD treatment or to be followed up in SDA patients with a single missing second molar and to demonstrate the efficacy of IFPD treatment in terms of the OHRQoL. Considering the aforementioned, these results may be useful when making clinical treatment decisions.

In conclusion, this study analyzed the association between the OHRQoL and the decision to be treated with

IFPDs in patients with an SDA missing a single second molar. The OHIP *Oral Function* and *Psychosocial Impact* dimension scores were significantly associated with the IFPD treatment choice. Treatment with IFPDs significantly improved the four OHIP dimension scores and the OHIP summary score by approximately 13 points. This suggests that treatment with IFPDs may be clinically beneficial for improving the OHRQoL in patients with an SDA who experience a decline in masticatory function.

Declaration of competing interest

The authors declare no competing interests relevant to this article.

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References

1. Gerritsen AE, Allen PF, Witter DJ, Bronkhorst EM, Creugers NH. Tooth loss and oral health-related quality of life: a systematic review and meta-analysis. *Health Qual Life Outcome* 2010;8:126.
2. Osunde OD, Efunkoya AA, Omeje KU. Reasons for loss of the permanent teeth in patients in Kano, north western Nigeria. *J West Afr Coll Surg* 2017;7:47—64.
3. Armellini D, von Fraunhofer JA. The shortened dental arch: a review of the literature. *J Prosthet Dent* 2004;92:531—5.
4. Käyser AF. Shortened dental arches and oral function. *J Oral Rehabil* 1981;8:457—62.
5. Reissmann DR, Wolfart S, John MT, et al. Impact of shortened dental arch on oral health-related quality of life over a period of 10 years — a randomized controlled trial. *J Dent* 2019;80:55—62.
6. Schierz O, Reissmann DR. Dental patient-reported outcomes — the promise of dental implants. *J Evid Base Dent Pract* 2021;21:101541.
7. Gerritsen AE, Witter DJ, Creugers NHJ. Long-term follow-up indicates unimpaired oral health-related quality of life for people having shortened dental arches. *J Dent* 2017;65:41—4.
8. Baba K, Igarashi Y, Nishiyama A, et al. Patterns of missing occlusal units and oral health-related quality of life in SDA patients. *J Oral Rehabil* 2008;35:621—8.
9. Manola M, Hussain F, Millar BJ. Is the shortened dental arch still a satisfactory option? *Br Dent J* 2017;223:108—12.
10. Greenstein G, Greenstein B, Carpentieri J. The need to replace a missing second molar with a dental implant restoration: analysis of a controversial issue. *Comp Cont Educ Dent* 2018;39:686—93.
11. Reissmann DR, Heydecke G, Schierz O, et al. The randomized shortened dental arch study: temporomandibular disorder pain. *Clin Oral Invest* 2014;18:2159—69.
12. Sarita PT, Kreulen CM, Witter DJ, van't Hof M, Creugers NH. A study on occlusal stability in shortened dental arches. *Int J Prosthodont* 2003;16:375—80.
13. Shiga H, Nakajima K, Uesugi H, Komino M, Sano M, Arai S. Reference value of masticatory performance by measuring the amount of glucose extraction from chewing gummy jelly. *J Prosthodont Res* 2022;66:618—22.
14. Horibe Y, Matsuo K, Ikebe K, et al. Relationship between two pressure-sensitive films for testing reduced occlusal force in diagnostic criteria for oral hypofunction. *Gerodontology* 2021;39:3—9.
15. Yamazaki M, Inukai M, Baba K, John MT. Japanese version of the oral health impact profile (OHIP-J). *J Oral Rehabil* 2007;34:159—68.
16. Slade GD, Spencer AJ. Development and evaluation of the oral health impact profile. *Community Dent Health* 1994;11:3—11.
17. John MT, Reissmann DR, Feuerstahler L, et al. Exploratory factor analysis of the oral health impact profile. *J Oral Rehabil* 2014;41:635—43.
18. John MT, Feuerstahler L, Waller N, et al. Confirmatory factor analysis of the oral health impact profile. *J Oral Rehabil* 2014;41:644—52.
19. Fueki K, Igarashi Y, Maeda Y, et al. Factors related to prosthetic restoration in patients with shortened dental arches: a multicentre study. *J Oral Rehabil* 2011;38:525—32.
20. Homsi G, Karlsson A, Almotairy N, Trulsson M, Kumar A, Grigoriadis A. Subjective and objective evaluation of masticatory function in patients with bimaxillary implant-supported prostheses. *J Oral Rehabil* 2023;50:140—9.
21. John MT, Rener-Sitar K, Baba K, et al. Patterns of impaired oral health-related quality of life dimensions. *J Oral Rehabil* 2016;43:519—27.
22. Wolfart S, Müller F, Gerß J, et al. The randomized shortened dental arch study: oral health-related quality of life. *Clin Oral Invest* 2014;18:525—33.
23. Wolfart S, Heydecke G, Luthardt RG, et al. Effects of prosthetic treatment for shortened dental arches on oral health-related quality of life, self-reports of pain and jaw disability: results from the pilot-phase of a randomized multicentre trial. *J Oral Rehabil* 2005;32:815—22.
24. Hosseini M, Worsaae N, Schiødt M, Gotfredsen K. A 3-year prospective study of implant-supported, single-tooth restorations of all-ceramic and metal-ceramic materials in patients with tooth agenesis. *Clin Oral Implants Res* 2013;24:1078—87.
25. John MT, Reissmann DR, Szentpétery A, Steele J. An approach to define clinical significance in prosthodontics. *J Prosthodont* 2009;18:455—60.