Factors associated with discontinuation and resumption of implant maintenance therapy

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Abstract: Discontinuation of implant maintenance is the main risk factor for implant failure. The purpose of this study was to identify factors associated with previous discontinuation and resumption of maintenance among implant patients. A questionnaire survey was sent to 171 patients receiving implant maintenance at a university hospital; 169 patients responded. To assess the effect of job status, 26 patients (15.4%) with a history of maintenance discontinuation were classified as employed and nonemployed. The main reasons for previously discontinuing maintenance were work issues (in employed respondents) and dissatisfaction with treatment skill or chairside manner (in nonemployed respondents). The main reasons for resuming maintenance were those related to dental treatment (in employed respondents) and awareness of the importance of maintenance (in nonemployed respondents). There were significant differences in relation to job status in the reasons reported for discontinuing and resuming maintenance (both P < 0.05). The present findings suggest that oral health professionals should consider these factors when assisting patients in reducing the risk of implant failure.

Keywords; discontinuation, implant failure, implant maintenance, patient education, peri-implantitis

Introduction

Implant treatment is an established, predictable treatment for replacing defective teeth [1,2] and increases quality of life by restoring occlusal support [3]. Many studies have reported an implant survival/success rate of 90% or higher [2,4-7]. However, for a variety of reasons, some implants fail. A review of 33 studies (including 1,320 patients and 8,376 implants [8]) reported an implant failure rate of 6.0% (after 1 year) to 12.3% (after 15 years). A recent study in China [9] reported that 1.3% of dental implants failed after 1-6 years. The main cause of implant failure is peri-implantitis, which is caused by bacterial infection [10,11]. Peri-implantitis spreads to the alveolar bone, which results in bone loss and, ultimately, implant loss [12,13]. The most important risk factors for implant failure include peri-implantitis caused by poor oral hygiene, smoking, history of periodontal disease, and diabetes [14,15].

Implant maintenance therapy helps patients to maintain good oral hygiene habits and improve their lifestyle, thus reducing the risk of peri-implantitis and implant failure [16-18]. A previous study of the effect of maintenance therapy on implant survival found that the implant failure rate was 90% lower in patients who attended regular maintenance therapy than in those who received no such therapy [19]. Oral health professionals treating implant patients need to motivate them to continue implant maintenance therapy, and information on factors associated with maintenance discontinuation in implant patients may be useful in this effort. A previous study reported that age, sex, and oral hygiene status were associated with maintenance discontinuation in implant patients [20]. However, few studies have investigated patients’ specific reasons for discontinuing implant maintenance. In addition, implant patients who have discontinued maintenance therapy should be encouraged to resume such therapy. Knowledge of the reasons for resuming implant maintenance therapy might be useful for encouraging other patients to restart maintenance. However, no studies have investigated implant patients’ specific reasons for resuming implant maintenance.

With the hope of preventing implant failure and maintaining patient quality of life, this study attempted to identify factors associated with discontinuing and resuming implant maintenance in a university hospital.

Materials and Methods

Study population

The present study was a self-administered questionnaire survey of 171 patients who visited Kyushu University Hospital for implant maintenance during the period from July through November 2016. The questionnaire comprised 9 sections: sex and age, job status, general disease status, medication use, smoking status, years of maintenance, history of maintenance discontinuation, reasons for maintenance discontinuation, and reasons for resuming maintenance. Job status was categorized as employed and nonemployed. Years of maintenance was categorized as <1 year, 1-3 years, 3-5 years, and ≥5 years.

The choices provided for reasons for maintenance discontinuation and resumption were extracted from studies of maintenance therapy [21,22], and consisted of 16 items categorized into 4 factors: dental factors (2 choices), physical factors (4 choices), oral health professional factors (5 choices), and social factors (5 choices). The 14 choices provided for reasons for resumption of maintenance were categorized into 3 factors: support factors (3 choices), dental treatment factors (8 choices), and other trigger factors (3 choices).

Information on patient oral status was extracted from their clinical records and included number of teeth present, number of missing teeth, number of dental implants, and sites of dental implants. The site of dental implants was classified as anterior, premolar, and molar. In addition, the distance between the home of the patient and hospital was recorded. To measure distance, the postal code of the patient’s home was obtained, and the direct distance between a representative point in the postal code and the hospital was measured by using the “measure distance” function of Google Maps (Google, Mountain View, CA, USA).

The research protocol was independently reviewed and approved by the ethical committee of Kyushu University, Fukuoka, Japan (date of approval: 19 July 2016; protocol number: 28-143). The study was performed in accordance with the ethical standards established in the 1964 Declaration of Helsinki, as revised in 2008.

Statistical analysis

The continuous variables age, distance from home to hospital, and oral status (number of teeth present, number of missing teeth, and number of dental implants) were compared between groups. Before the comparison, the Shapiro-Wilk test showed that the data for the above 5 variables were not normally distributed (P < 0.01), and the Mann-Whitney was thus used for the comparisons. Comparisons of categorical variables were done with the chi-square (χ²) test. Additionally, a logistic regression analysis was performed, with discontinuation of maintenance as the objective variable and other characteristics as explanatory variables. A variable model with a good fit was identified by using a stepwise method (backward elimination).
Results were considered significant if the P-value was less than 0.05. SPSS for Windows (Ver. 23.0, IBM, Tokyo, Japan) was used for all analyses.

Results

A total of 169 implant patients who visited the university hospital for implant maintenance during the study period were included in the study (effective response rate, 98.8%). Table 1 shows the characteristics of respondents who had and had not previously discontinued maintenance; 26 participants (15.4%) had previously discontinued maintenance and 143 (84.6%) had not. Most participants in both groups were female, namely, 80.8% of those who had discontinued maintenance and 82.2% who had never discontinued maintenance. The mean age was 65.9 years in patients who had discontinued maintenance and 65.7 years in patients who had never discontinued maintenance. The mean age was 62.2 years in patients who had previously discontinued maintenance and 65.7 years in patients who had not. Most participants in both groups were female, namely, 73.1% of those who had discontinued maintenance and 65.7 years in patients who had never discontinued maintenance. The mean age was 65.9 years in patients who had discontinued maintenance and 65.7 years in patients who had never discontinued maintenance. Most patients in both groups were non-employed, namely, 73.1% of those who had discontinued maintenance and 65.7 years in patients who had never discontinued maintenance. The mean age was 65.9 years in patients who had discontinued maintenance and 65.7 years in patients who had never discontinued maintenance. The mean age was 62.2 years in patients who had previously discontinued maintenance and 65.7 years in patients who had not. Most participants in both groups were female, namely, 80.8% of those who had discontinued maintenance and 82.2% who had never discontinued maintenance. The percentage of women was higher among respondents who had discontinued maintenance than among those who had not, but the difference was not significant (P = 0.068). There was no significant difference between groups in distance from home to hospital, age, job status, general disease status, medication use, smoking status, years of maintenance, oral status, or dental implant site.

Table 2 shows factors associated with maintenance discontinuation. Because the median number of implants placed in this cohort was 3, respondents were classified as those with 3 or fewer and 4 or more implants. Women and patients with 4 or more implants were significantly more likely to discontinue maintenance. The odds ratios (95% confidence interval) for maintenance discontinuation, in relation to sex and number of implants, were 2.98 (1.03-8.56) and 3.58 (1.23-10.4), respectively.

Table 3 shows the reasons for maintenance discontinuation, in relation to job status. Fourteen participants (53.8%) reported dental treatment as the reason for maintenance discontinuation. Only 2 participants (7.6%) reported medical factors such as injury/hospitalization and being in poor physical condition as reasons for maintenance discontinuation. Analysis of factors related to oral health professionals revealed that 7 (36.8%) and 4 (21.1%) nonemployed participants cited dissatisfaction with treatment skills and chairside manner, respectively, as reasons, although no employed respondent cited these reasons. One nonemployed participant (3.5%) reported insufficient explanation of maintenance therapy as a reason. One nonemployed participant (3.5%) reported insufficient explanation of maintenance therapy as a reason. Analysis of factors related to oral health professionals revealed that 7 (36.8%) and 4 (21.1%) nonemployed participants cited dissatisfaction with treatment skills and chairside manner, respectively, as reasons, although no employed respondent cited these reasons. One nonemployed participant (3.5%) reported insufficient explanation of maintenance therapy as a reason. Analysis of social factors showed that 5 (71.5%) employed respondents and 4 (21.1%) nonemployed participants reported being too busy or work issues as reasons. There was a significant difference between employed and nonemployed respondents in reporting work issues as a reason for discontinuing maintenance (P < 0.05). However, there was no significant sex or age difference in the reasons for discontinuation.

Table 4 shows reasons for resuming maintenance, by job status. Twelve participants (46.2%) cited their own willingness as the reason for resuming

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### Table 1

| Characteristic                  | Yes (n = 26) | No (n = 143) | P-value (χ²-test) |
|---------------------------------|-------------|-------------|------------------|
| Sex                             |             |             |                  |
| Male (%)                        | 5 (19.2)    | 54 (37.8)   | 0.068*           |
| Female (%)                      | 21 (80.8)   | 89 (62.2)   |                  |
| Age                             | 65.9        | 65.7        | 0.772*           |
| Distance from home to hospital (km) | 20.48    | 27.01       | 0.636*           |
| Job status                      |             |             |                  |
| Employed                        | 7 (26.9)    | 49 (34.3)   | 0.464*           |
| Nonemployed                     | 19 (73.1)   | 94 (65.7)   |                  |
| General disease                 |             |             |                  |
| Yes (%) / No (%)                | 10 (38.5) / 16 (61.5) | 70 (49.0) / 73 (51.0) | 0.324*           |
| Medication status               |             |             |                  |
| Yes (%) / No (%)                | 15 (57.7) / 11 (42.3) | 78 (54.5) / 65 (45.5) | 0.767*           |
| Smoking status                  |             |             |                  |
| Smoker (%) / No (%)             | 2 (7.7)    | 13 (9.1)    | 0.818*           |
| Non-smoker (%)                  | 24 (92.3)   | 130 (90.9)  |                  |
| Years of maintenance            |             |             |                  |
| <1 year                         | 1 (3.8)     | 20 (14.0)   | 0.466*           |
| 1-3 years                       | 11 (42.3)   | 54 (37.8)   |                  |
| 3-5 years                       | 7 (26.9)    | 41 (28.7)   |                  |
| ≥5 years                        | 7 (26.9)    | 28 (19.6)   |                  |
| Oral status                     |             |             |                  |
| Number of teeth present         | 19.35       | 18.36       | 0.763*           |
| Number of missing teeth         | 7.62        | 9.42        | 0.282*           |
| Number of dental implants       | 5.04        | 4.21        | 0.410*           |
| Site of dental implants         |             |             |                  |
| Anterior                        |             |             |                  |
| Yes (%) / No (%)                | 8 (30.8) / 18 (69.2) | 50 (35.0) / 93 (65.0) | 0.678*           |
| Premolar                        |             |             |                  |
| Yes (%) / No (%)                | 18 (69.2) / 8 (30.8) | 96 (67.1) / 47 (32.9) | 0.834*           |
| Molar                           |             |             |                  |
| Yes (%) / No (%)                | 21 (80.8) / 5 (19.2) | 122 (85.3) / 21 (14.7) | 0.555*           |

*P < 0.05

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### Table 2

| Characteristic | Odds ratio 95% confidence interval | P-value* |
|----------------|-----------------------------------|---------|
| Sex            |                                    |         |
| Male           | 1.00                               | -       | 0.043   |
| Female         | 2.98                               | 1.03-8.56 |         |
| Number of dental implants |                  |         |
| ≤3                          | 1.00                               | -       | 0.019   |
| >3                          | 3.58                               | 1.23-10.4 |       |

*Logistic regression analysis with backward elimination was used to obtain P-values.
The association between sex and previous maintenance discontinuation is more likely to have discontinued maintenance. These findings suggest that, in this study, women were significantly more likely than men to have discontinued maintenance. However, a similar study \[20\], in the implant department of a university hospital, reported that men were significantly more likely to have discontinued maintenance. This suggests that, for nonemployed patients, sufficient explanation of implant treatment and improvement of professional skills should be carefully managed for employed patients. The main reasons for maintenance discontinuation among employed respondents were social factors such as being too busy or work issues. Additionally, significantly more employed patients than nonemployed patients cited dental treatment factors as their reason for resuming maintenance. There was no significant difference in relation to sex or age in the reasons given for resuming maintenance.

**Discussion**

In this study, women were significantly more likely than men to have discontinued maintenance. However, a similar study \[20\], in the implant department of a university hospital, reported that men were significantly more likely to have discontinued maintenance. These findings suggest that the association between sex and previous maintenance discontinuation in patients currently receiving maintenance differs from the association between sex and maintenance discontinuation. Presence of a high number of implants was significantly associated with previous maintenance discontinuation, perhaps because patients who had lost more teeth had less interest in their health. Some previous studies reported that presence of a high number of implants was a risk factor for implant failure \[23,24\]. Therefore, to prevent new discontinuation of maintenance, oral health professionals should explain the relevant risk factors to patients who previously discontinued maintenance.

The main reasons for maintenance discontinuation among employed respondents were social factors such as being too busy or work issues. Additionally, significantly more employed patients than nonemployed patients cited work issues as a reason for discontinuation. This suggests that, to prevent maintenance discontinuation, maintenance schedules should be carefully managed for employed patients. The main reasons for previous discontinuation among nonemployed patients were oral health professional factors such as dissatisfaction with treatment skills or chairside manner. These results suggest that, for nonemployed patients, sufficient explanation of implant treatment and improvement of professional skills

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### Table 3 Reasons for previous maintenance discontinuation, by job status (multiple answers permitted)

| Factors related to oral health professionals | Total (n = 26) | Employed (n = 7) | Nonemployed (n = 19) | P-value* |
|----------------------------------------------|---------------|-----------------|----------------------|---------|
| Dental factors                               |               |                 |                      |         |
| Treatment                                    |               |                 |                      |         |
| No dental pain                               | 12 (46.2)     | 3 (42.9)        | 9 (47.4)             | 0.838   |
| Total                                        | 26 (100)      | 7 (100)         | 19 (100)             |         |
| Physical factors                             |               |                 |                      |         |
| Discontinuation of treatment skill           | 6 (23.1)      | 2 (28.6)        | 4 (21.1)             | 0.187   |
| Diminished motivation                        | 5 (19.2)      | 1 (14.3)        | 4 (21.1)             | 0.093   |
| Lack of awareness of importance of maintenance | 4 (15.4)   | 1 (14.3)        | 3 (15.8)             | 0.463   |
| Total                                        | 15 (57.7)     | 5 (71.4)        | 10 (52.6)            |         |
| Factors related to oral health professionals |               |                 |                      |         |
| Total                                        | 26 (100)      | 7 (100)         | 19 (100)             |         |

*χ² test

### Table 4 Reasons for resuming maintenance, by job status (multiple answers permitted)

| Factors related to oral health professionals | Total (n = 26) | Employed (n = 7) | Nonemployed (n = 19) | P-value* |
|----------------------------------------------|---------------|-----------------|----------------------|---------|
| Support factors                              |               |                 |                      |         |
| Patient’s willingness                        | 12 (46.2)     | 3 (42.9)        | 9 (47.4)             | 0.838   |
| Contact from hospital                        | 0 (0.0)       | 0 (0.0)         | 0 (0.0)              |         |
| Advice from family                          | 0 (0.0)       | 0 (0.0)         | 0 (0.0)              |         |
| Total                                        | 12 (46.2)     | 3 (42.9)        | 9 (47.4)             |         |
| Dental treatment factors                     |               |                 |                      |         |
| Removal of dental calculus or stain          | 4 (15.4)      | 2 (28.6)        | 2 (10.5)             | 0.258   |
| Treatment of periodontal disease            | 3 (11.5)      | 3 (42.9)        | 0 (0.0)              | 0.002   |
| Treatment of implant                        | 3 (11.5)      | 2 (28.6)        | 1 (5.3)              | 0.099   |
| Dental pain                                 | 1 (3.8)       | 1 (14.3)        | 0 (0.0)              | 0.093   |
| Treatment of dental caries                  | 1 (3.8)       | 1 (14.3)        | 0 (0.0)              | 0.093   |
| Treatment of dentures                       | 1 (3.8)       | 1 (14.3)        | 0 (0.0)              | 0.093   |
| Whitening treatment                         | 1 (3.8)       | 1 (14.3)        | 0 (0.0)              | 0.093   |
| Breath treatment                            | 1 (3.8)       | 1 (14.3)        | 0 (0.0)              | 0.093   |
| Total                                        | 15 (57.7)     | 12 (171.4)      | 3 (15.8)             |         |
| Other trigger factors                        |               |                 |                      |         |
| Awareness of importance of maintenance      | 8 (30.8)      | 3 (42.9)        | 5 (26.3)             | 0.093   |
| Willingness to see dentist in charge         | 1 (3.8)       | 0 (0.0)         | 1 (5.3)              | 0.418   |
| Willingness to see dental hygienist in charge| 1 (3.8)   | 0 (0.0)         | 1 (5.3)              | 0.093   |
| Total                                        | 11 (42.3)     | 3 (42.9)        | 8 (42.1)             |         |

*χ² test
such as dental treatment and chairside manner may be important in preventing maintenance discontinuation.

Regarding support factors as reasons for resuming maintenance, no respondent cited contact from the hospital or advice from family as a reason for resuming implant maintenance. The recall system for patients who discontinued maintenance was not well established in the university hospital and relied on the dentists in charge of patients. A study of the effectiveness of a recall system reported that telephone calls or letter reminders were cost-effective in reducing no-show rates [25], which suggests that a reminder system could be effective in preventing discontinuation and encouraging resumption of implant maintenance.

The main reasons for resuming maintenance among employed respondents were treatment factors (such as removal of dental calculus or stain, treatment of periodontal disease, and implant treatment) and the trigger factor of awareness of the importance of maintenance. Employed respondents were significantly more likely to cite periodontal treatment as a reason for resuming maintenance, which suggests that oral health professionals caring for employed patients should carefully explain the risks of peri-implantitis and implant failure caused by maintenance discontinuation. Among nonemployed participants, the main reason for resuming maintenance was awareness of the importance of maintenance. Several nonemployed patients reported wanting to see the oral health professional in charge as a reason for resuming maintenance. These results highlight the importance of clearly explaining the importance of maintenance to nonemployed patients and of building a good relationship between oral health professionals and patients during maintenance, to encourage patients to resume maintenance after discontinuation.

Several limitations of this study warrant mention. First, only implant patients in 1 university hospital were studied. The hospital is closed on Saturdays, Sundays, and public holidays, and reception closes at 4 PM. In contrast, private clinics in Japan are usually open on weekday evenings and Saturdays. Thus, the present cohort is not necessarily representative of all implant patients in Japan. In addition, patients who seek treatment in university hospitals may travel farther than those going to private clinics and usually experience longer waiting times in the reception area and waiting room. Although distance from home to hospital was not associated with maintenance discontinuation in the present study, maintenance discontinuation may differ between patients at hospitals and those at clinics. To further understand patient attitudes toward maintenance continuity/discontinuity, future studies should enroll a larger number of patients, including patients at private clinics.

The reasons identified for discontinuation were cited by patients receiving maintenance who had previously discontinued maintenance, and these reasons might differ from those cited by patients who had discontinued and never resumed implant maintenance. However, the reasons cited by patients receiving maintenance who had previously discontinued maintenance resulted in successful resumption of maintenance and are therefore useful information for preventing discontinuation and promoting resumption of maintenance.

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Conflict of interest
The authors declare no conflict of interest.

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