Surgical Treatment of Furcation Involvement Associated with Recurrence of Aggressive Periodontitis: A Case Report

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Abstract

Here, we report a case of generalized chronic periodontitis with furcation involvement that was treated successfully by means of surgical intervention. The patient was a 43-year-old man requesting treatment for periodontal disease. An initial examination revealed 42% of sites with a probing depth of ≥4 mm and 42.9% of sites with bleeding on probing. The maxillary molars showed varying degrees of furcation involvement. Radiographic examination revealed bone resorption in the molar and mandibular anterior teeth regions. Microbiological examination of subgingival plaque revealed the presence of Porphyromonas gingivalis, Aggregatibacter actinomycetemcomitans, and Tannerella forsythia. The patient’s oral health-related quality of life (OHRQL) was also assessed. Based on a clinical diagnosis of severe chronic periodontitis, initial periodontal therapy was performed. Plaque control, scaling and root planing, extraction, temporary fixed restoration, occlusal adjustment, and root canal treatment were implemented. Following reevaluation, open flap debridement was performed at selected sites. Root resection was performed on the distal root of #16. Prosthetic treatment was then initiated for recovery of oral function. After confirmation of appropriate occlusion and cleanability, the patient was placed on supportive periodontal therapy. Root resection improved cleanability. This clinical improvement has been adequately maintained over a 2-year period. The patient’s OHRQL score showed a slight deterioration during the supportive periodontal therapy OK period, however. This indicates the need for further careful monitoring of periodontal conditions, as well as of how they are perceived by the patient themselves.

Key words: Furcation involvement — Root resection — Quality of life
Introduction

The main goal of periodontal treatment is to reduce the amount of periodontopathic bacteria, thereby creating an environment that can be managed more easily solely through maintenance of good oral hygiene. During such periodontal treatment, daily maintenance of oral hygiene is crucial; and even after clinical conditions have stabilized, good oral hygiene practices must be continued to reduce the risk of recurrence of periodontal disease.

There is a tendency toward an increase in periodontopathic bacteria where root shapes are complex, which functions as an obstacle to adequate self-care. Furcation involvement is a condition in which the periodontal tissue of the interradicular septum of a multiple-root tooth has been destroyed. The treatment plan for furcation involvement depends on the degree of progression of the condition. The anatomical features of the maxillary first molars include 2 buccal roots and 1 palatal root, which makes it difficult to gain access to areas of furcation. The maxillary molars have buccal, mesial, and distal openings, and the presence of neighboring teeth makes it difficult to check or gain access to the furcation during treatment. Therefore, as furcation involvement progresses, the frequency of root resection and trisection of the maxillary molars increases.

Here, we report a case of periodontal surgery including root resection for chronic periodontitis with furcation involvement that has been successfully followed up for over 2 years.

Case Presentation

Written informed consent was obtained from the patient for inclusion in this report.

1. Baseline examination

In July 2015, a 43-year-old man visited Tokyo Dental College Chiba Hospital requesting treatment for periodontal disease due to gingival discomfort. The general health of the patient was good. He had already received periodontal treatment, including periodontal surgery, about 20 years earlier. Initially, after this first round of care, conditions had remained stable. Periodontal disease began to recur; however, within 10 years. Despite the scaling and root planing (SRP) he had received at that time, the periodontal disease progressed, and some of the teeth in which the prognosis was hopeless had subsequently been extracted.

On his first visit to our department, gingival inflammation was mostly evident in the maxillary molars, maxillary left canine, and mandibular anterior teeth (Fig. 1). Buccal inclination was observed in #17 and 28. Extrusion was observed in #16, 28, and 42, while #37, 46, and 47 were missing. Premature contact was observed in #18 and 48.

The results of the periodontal examination are shown in Fig. 2. They revealed that 28.6% of sites had a probing depth (PD) of 4–5 mm and 13.7% a PD of ≥6 mm. Furcation involvement was Degree 2 buccal and mesial and Degree 1 distal in #16; and Degree 1 buccal in #17 and mesial in #26. The mean PD was 4.0 mm. Bleeding on probing (BOP) was observed in 42.9% of sites. The level of plaque control as assessed according to the O’Leary plaque control record (PCR) was 30%.

Radiographic examination (Fig. 3) revealed angular bone defects in #16, 26, 31, and 42, and widening of the periodontal ligament space in #18, 42, and 48. For microbiological examination, samples of subgingival plaque were obtained with sterile paper points from the deepest pockets in the bilateral maxillary and mandibular regions. They were then transferred into sampling tubes supplied in a commercial kit (Saliva-Check Lab, GC, Tokyo, Japan) and sent to a microbiological testing laboratory (GC Oral Check Center, Tokyo) for quantitative detection of Porphyromonas gingivalis, Aggregatibacter actinomycetemcomitans, and Tannerella forsythia using real-time PCR. Total bacterial count at baseline was $6.5 \times 10^3$ copies. The values for P. gingivalis, A. actinomycetemcomitans, and T. forsythia were
6.3 × 10^2 (comprising 9.6% of the total bacterial count), 3.3 × 10^2 (5.1%), and 8.7 × 10^2 (1.3%), respectively. As a measure of patient-reported outcome, oral health-related quality of life (OHRQL) was also assessed\textsuperscript{26}, with the result showing a total score of 2.

2. Diagnosis

The clinical diagnosis was generalized severe chronic periodontitis\textsuperscript{1} (Stage III,
Grade C). A treatment plan was presented to the patient and his consent for its implementation obtained.

3. Clinical procedures and outcomes

1) Treatment plan
   1) Initial periodontal therapy
      This comprised oral hygiene instruction, extraction of teeth with a hopeless prognosis (#18, 28, 42, and 48), quadrant SRP, root canal treatment in #16, and a temporary fixed restoration in #31, 32, 33, 41, and 43.
   2) Reevaluation
   3) Periodontal surgery
      This comprised open flap debridement at sites with a PD of ≥4 mm and root resection for furcation involvement in #16.
   4) Reevaluation
   5) Treatment for recovery of oral function
      This comprised placement of a fixed bridge for #31–43 and a removable partial denture for #37, 46, and 47.
   6) Reevaluation
   7) Supportive periodontal therapy (SPT) or maintenance

2) Treatment process
   An outline of the treatment process is shown in Table 1.
   1) Initial periodontal therapy
      After obtaining informed consent for the proposed treatment plan, instruction was given on plaque control. A series of quadrant SRP was then performed, and #18, 28, 42, and 48 were extracted due to a hopeless prognosis. Provisional restorations were placed on #31–43. Root canal treatment was also performed, as #16, 31, and 41 showed persistent hypersensitivity.
   2) Reevaluation
      Subsequent reevaluation revealed a reduction in the PCR score to 20%. Sites with a PD of 4–5 mm decreased to 21.5%, while those with a PD of ≥6 mm decreased to 4.9%. The mean PD was 3.2 mm. Prevalence of BOP was

| Table 1 | Treatment process |
|---------|-------------------|
| **July 2015** | Initial periodontal therapy |
|          | · Oral hygiene instruction |
|          | · Quadrant SRP |
|          | · Extraction of teeth (#18, 28, 42, 48) |
|          | · Fixed of temporary bridge (#31, 41, 43) |
|          | · Root canal treatment (#16, 31, 41) |
| **May 2016** | (Reevaluation) Surgical periodontal therapy |
|          | · Root resection (#16), Open flap debridement (#15, 16, 17) |
|          | · Open flap debridement (#25, 26, 27) |
|          | · Open flap debridement (#31, 32, 41) |
| **June 2017** | (Reevaluation) Treatment for recovery of oral function |
|          | · Full metal crown (#16) |
|          | · Bridge (# 31-41 42 43 ) |
|          | · Removable partial denture (#37, 46, 47) |
| **September 2017** to present | (Reevaluation) SPT |
|          | · Oral hygiene instruction |
|          | · Professional tooth cleaning |
were observed in 64%. These results were judged to be “insufficient” according to the criteria for the success of non-surgical periodontal therapy. Total bacterial count at reevaluation was $3.2 \times 10^3$ copies. The value for \textit{P. gingivalis} was $2.6 \times 10^5$ (comprising 8.1% of the total bacterial count). \textit{A. actinomycetemcomitans} and \textit{T. forsythia} were below the detection limit. The total OHRQL score was 2.

(3) Periodontal surgery

Based on the results of the reevaluation, the need for periodontal surgery was explained and consent for its implementation obtained. Open flap debridement was implemented for #16, 17, 25, 26, 31, 32, and 41 to reduce periodontal pockets (Figs. 4–6). Root resection was performed on the distal root for the furcation involvement in #16. The other remaining periodontal pockets in #23, 24, 27, 33, 34, 36, and 45 were subjected to a second round of SRP.

(4) Reevaluation

Improvements in gingival inflammation and PD were observed at the site where periodontal surgery and a second round of SRP were performed. The patient’s level of plaque control was adequate (PCR score, 18.8%). The furcation involvement in #16 and 26 remained, but PD improved to 2–3 mm. The furcation involvement in #17 improved. The mean PD was 2.1 mm. There was resolution of tooth mobility in #31, 32, and 41. Total bacterial count at reevaluation was $8.7 \times 10^5$ copies. \textit{P. gingivalis}, \textit{A. actinomycetemcomitans}, and \textit{T. forsythia} were below the detection limit. The total OHRQL score was 3.

(5) Treatment for recovery of oral function

Final prostheses were placed on #31–43 (a fixed bridge); a full metal crown was placed on #16. A removal partial denture was fabricated for teeth #37, 46, and 47.

(6) Reevaluation

The patient’s level of plaque control was adequate (PCR score, 17.7%). The mean PD was 2.2 mm. Total bacterial count at reevaluation was $2.6 \times 10^5$ copies. \textit{P. gingivalis}, \textit{A. actinomycetemcomitans}, and \textit{T. forsythia} remained.

Fig. 4  Periodontal surgery (#16 root resection, and #15 and 17 open flap debridement)

Fig. 5  Periodontal surgery (#25 and 26 open flap debridement)

Fig. 6  Periodontal surgery (#31, 32, and 41 open flap debridement)
undetected. The total OHRQL score was 2. Furcation involvement was observed in #16 and 26. The periodontal conditions were stable, however, and the patient was placed in a recall system for SPT. Based on the results of periodontal risk assessment\(^{14}\), the risk at SPT was judged to be moderate due to the effects of the percent of alveolar bone loss and the number of teeth lost. Therefore, the recall period was set to once a month.

(7) SPT

During 2 years of SPT, periodontal conditions remained stable (Figs. 7–9). Furcation involvement was still observed in #16 and 26. The mean PD was 2.1 mm. Total bacterial count at reevaluation was \(2.7 \times 10^4\) copies. \(P. gingivalis\), \(A. actinomycetemcomitans\), and \(T. forsythia\) were below the detection limit (Fig. 10). The total OHRQL score was 3. Presently, the recall period is set to once every two months.

**Discussion**

In the present case, severe destruction of periodontal tissue was observed to be localized to the molars and mandibular anterior teeth. These conditions were presumed to be due to the recurrence of previously-treated aggressive periodontitis. The destruction of periodontal tissue in the molar region had resulted in furcation involvement. The main
causes of furcation involvement include the spread of inflammation from marginal periodontal tissue, traumatic occlusion, and the combination of periodontal and endodontic lesions. The extent of the spread is related to the enamel projection, degree of root separation, root morphology, and root trunk length. The method of treatment selected will depend on the extent of the spread. In the present case, the left and right maxillary first molars showed varying degrees of furcation involvement. Therefore, treatment was selected according to the degree of progression at each individual site. The furcation involvement in #17 and 26 was treated successfully with open flap debridement. Tooth #16 showed Degree 2 buccal and mesial and Degree 1 distal furcation involvement, however. During surgery, marked bone resorption was observed around the distal root, necessitating resection. Regarding the furcation involvement in the maxillary first molars, it has been shown that the distal region generally shows greater destruction than other root aspects. Root resection is a sensitive and complex technique, so proper case selection is essential. The prognosis for root resection has been well documented in previous studies, but the factors that affect the survival of resected molars have not been discussed in detail. Langer et al. reported that 38% of teeth with root resection were lost after 10 years. Park et al. reported that 29.8% of resected molars failed, and that 50% of these failures were related to periodontal problems. Carnevale et al. reported otherwise, with a 6.9% failure rate over 10 years. Megarbane JM et al. reported that 92 teeth that were followed over a range of from 5 to 40 years showed a survival rate of 94.8%. These differences may be explained by the inclusion criteria and maintenance program adopted in these studies. Root resection allows removal of deposited periodontopathic bacteria and dental calculus that cannot be otherwise eliminated. It also allows removal of unwanted anatomic features that may serve as bacteria reservoirs in the future. Careful postoperative plaque control is necessary, however.

In the present case, the mean PD improved over the course of treatment, and the levels of the three periodontopathic bacteria investigated also showed a decrease (Table 2). This result is consistent with the report by Doungu-domdacha et al., which showed that periodontopathic bacteria decreased with improved PD. After periodontal surgery in the present case, the left and right maxillary first molars showed varying degrees of furcation involvement. Therefore, treatment was selected according to the degree of progression at each individual site. The furcation involvement in #17 and 26 was treated successfully with open flap debridement. Tooth #16 showed Degree 2 buccal and mesial and Degree 1 distal furcation involvement, however. During surgery, marked bone resorption was observed around the distal root, necessitating resection. Regarding the furcation involvement in the maxillary first molars, it has been shown that the distal region generally shows greater destruction than other root aspects. Root resection is a sensitive and complex technique, so proper case selection is essential. The prognosis for root resection has been well documented in previous studies, but the factors that affect the survival of resected molars have not been discussed in detail. Langer et al. reported that 38% of teeth with root resection were lost after 10 years. Park et al. reported that 29.8% of resected molars failed, and that 50% of these failures were related to periodontal problems. Carnevale et al. reported otherwise, with a 6.9% failure rate over 10 years. Megarbane JM et al. reported that 92 teeth that were followed over a range of from 5 to 40 years showed a survival rate of 94.8%. These differences may be explained by the inclusion criteria and maintenance program adopted in these studies. Root resection allows removal of deposited periodontopathic bacteria and dental calculus that cannot be otherwise eliminated. It also allows removal of unwanted anatomic features that may serve as bacteria reservoirs in the future. Careful postoperative plaque control is necessary, however.

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In the present case, the target periodontopathic bacteria were undetected. Removal of inflammatory granulation tissue in periodontal surgery is effective in removing subgingival plaque that invades periodontal tissue\(^7\). Prevention of deepening of periodontal pockets by plaque control leads to suppression of subgingival plaque growth.

In relation to the anatomical features present at a furcation, plaque control is difficult at the distal furcation in the upper first molar\(^21\). In the present case, the furcation could be directly accessed by using a tufted brush when performing resection of the distal root. Although the level of plaque control was adequate, the risk assessment\(^14\) indicated moderate risk due to the percent bone loss and number of teeth lost. Carnevale \textit{et al.}\(^6\) reported a 93% survival rate with SPT at 2 to 6-month intervals. This indicates the need to check plaque control by recall and pay close attention to recurrence of periodontal disease. In the present case, the total OHRQL score at first visit was significantly lower than the mean value reported previously\(^26\), and this score changed over the course of treatment. The OHRQL score slightly worsened during the SPT period, however, due to the score obtained for “health perceptions”. This indicates the need for further careful monitoring of periodontal conditions, as well as of how they are perceived by the patient themselves.

### Table 2

|                           | At first visit | Post-IP | Post-OP | SPT: start | SPT: 2Y |
|---------------------------|---------------|---------|---------|------------|---------|
| Total bacteria            | 6500          | 3200    | 870     | 26000      | 2700    |
| \(P_g\)                   | 630           | 260     | —       | —          | —       |
| \(A_a\)                   | 330           | —       | —       | —          | —       |
| \(T_f\)                   | 87            | —       | —       | —          | —       |

IP, initial periodontal therapy; OP, operative; SPT, supportive periodontal therapy; —, at the detection limit

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