

# Multidisciplinary Approach for the Treatment of Maxillary Anterior Teeth by Tooth Movement Following Enucleation and Bleaching : A Case Report

Yunmi Kim<sup>1,†</sup>, Namkwon Lee<sup>2,†</sup>, Wonse Park<sup>3</sup>, Jieun Cheong<sup>4</sup>

<sup>1</sup>Ph.D., Department of Orthodontics, Yonsei University, Seoul, Republic of Korea

<sup>2</sup>Postgraduate Student, Department of Advanced General Dentistry, Yonsei University, Seoul, Republic of Korea

<sup>3</sup>Professor, Department of Advanced General Dentistry, Yonsei University, Seoul, Republic of Korea

<sup>4</sup>Assistant Professor, Department of Advanced General Dentistry, Yonsei University, Seoul, Republic of Korea

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## ABSTRACT

Treatment of the maxillary anterior region requires not only functional but also aesthetic. So dentist should make a diagnosis and treatment plan considering patient's esthetics as well as eliminating dental disease such as dental caries, periodontal disease, periapical pathology, and malocclusion. Comprehensive treatment planning for surgical, endodontic and orthodontic treatment planning is mandatory for fulfill these goals. In this case report, a 36-year-old male patient who complained of palatal pain visited the Department of Advanced General Dentistry at Yonsei University. He had a history of dental trauma and he had experienced aesthetic discomfort caused by crowding and right central incisal discoloration. Radiography revealed supernumerary tooth (SNT) and well-defined radiolucent lesion on the apex of upper the central incisor. Right central incisor exhibited loss of vitality. A comprehensive approach involving endodontic treatment, cyst enucleation, apicoectomy, orthodontic treatment, and bleaching of the upper anterior teeth was required, which allowed functional and esthetic restoration within a short period of time.

**Key words :** Comprehensive treatment, Endodontic treatment, Cyst enucleation, Apicoectomy, Orthodontic treatment, Bleaching

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## INTRODUCTION

Esthetic demand is still increasing in dental field and treating maxillary anterior teeth has a very high impact on not only patient's esthetics but also satisfaction. So dentist should make a diagnosis and treatment plan considering patient's esthetics as well as eliminating dental disease such as dental caries, periodontal disease, periapical pathology, and malocclusion. Comprehensive treatment planning for surgical, endodontic and orthodontic treatment planning is mandatory for fulfill these goals.

One of the patient's concerns during treatment of maxillary anterior area is total treatment time. Patients are very sensitive at long treatment time and devices attached in maxillary anterior teeth. Recently, accelerated tooth movement combined with surgical treatments such as corticotomy, osteotomy, and periodontal ligament distraction, can be an option for shortening treatment time during orthodontic treatment. However, the surgical intervention can not be a first option for shortening treatment time because they still have a chance for postoperative complications like loss of tooth vitality, periodontal problems, or severe root resorption. But if patient have pathologic disease that should be surgical treatment, it could shorten the treatment time if properly scheduled.

In the case report presented here, we will present a male patient who complained of pain, discoloration, and crowding of the maxillary anterior teeth. Surgical intervention was neces-

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<sup>†</sup> Both authors contributed equally to this work.

Correspondence : Assistant Professor, Jieun Cheong, D.D.S., M.S.D., Ph.D.  
Department of Advanced General Dentistry, College of Dentistry, Yonsei University, 50 Yonseiro, Seodaemungu, Seoul, Republic of Korea  
Tel: +82-2-2228-8979, fax: +82-2-2227-8906  
E-mail: jjeah16@yuhs.ac

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sary due to the presence of a cyst with supernumerary teeth in maxillary anterior area, which was in contact with the apex of those teeth. Comprehensive procedure including orthodontic treatment and tooth bleaching was also required for esthetic purposes. All of the designated treatments (i.e., cyst enucleation surgery, endodontics, orthodontics, and tooth whitening) were carried out using a comprehensive approaches; functional and esthetically satisfactory results were achieved.

## CASE REPORT

### 1. Diagnosis and etiology

A 36-year-old male patient whose chief complaint was palatal pain visited the Department of Advanced General Dentistry at Yonsei University. He had a history of dental trauma as a result of falling from a bicycle and banging his teeth on the ground 5 years prior to this visit. At that time he had experienced a little discomfort and right central incisal discoloration, but he did not receive any dental treatment. Two months prior to this visit he felt pain in the hard palatal area and visited local dental clinic, but he did not perceive any improvement in his condition. So he visited our department with a desire to achieve pain control and to get orthodontic treatment for upper anterior crowding (Fig 1).

Clinical examination revealed discoloration of the right central maxillary incisal tooth; the tooth was darker (shade A3) than the adjacent teeth (shade A2) and exhibited loss of vitality [cold (-), percussion (+), mobility (-)]. The left central maxillary incisal tooth and both maxillary lateral incisal teeth were vital. There was crowding of the four maxillary and mandibular incisors and there was generalized gingival swelling and redness suggesting mild gingival inflammation.

Periapical radiography revealed supernumerary teeth (SNT) and a well-defined radiolucent lesion in the apex of maxillary central incisor (Fig 2); cone-beam computed tomography was taken localization of the cyst and SNT, and two SNT's were found located in the palatal side (Fig 3). There were external root resorptions at the apex of maxillary left and right incisal teeth. No other specific findings were found.

Based on those informations, the overall diagnosis was as follows:

1. Pulpless tooth on #11, impaction of SNT on the root apices of #11 and #21 (palatal side).
2. Nasopalatine duct cyst or dentigerous cyst suspected in

the area of the root apices of #11 and #21.

3. Generalized marginal gingivitis.

Additional orthodontic analysis was performed for orthodontic treatment after cyst enucleation. The chief orthodontic complaint was aesthetic due to upper anterior crowding; the patient had normal profile and smile arc, and was thus satisfied with his general appearance. Both the canines and molars had a class I occlusion (i.e., neutroclusion), and an arch length discrepancy (ALD) of 3.8 mm in the maxilla and 3.3 mm in the mandible. The sum of incisors was 4:2.88, with the upper 6 anterior teeth being larger than the lower 6 anterior teeth. The dimensions of the overjet and overbite were 3.0 and 3.5 mm, respectively. The midline of the maxilla was shifted by 1.5 mm to the right side due to rotation of the maxillary right central incisor. Labioversion was observed on both upper second molars. The patient was thus diagnosed as class I with mild crowding of the anterior teeth.

### 2. Treatment objectives

First of all, the removal of SNT and cyst in maxillary anterior incisal area for removal of infection source. After that, the objectives of orthodontic treatment were (1) correction of upper and lower anterior teeth relationship through de-crowding, (2) relief of maxillary right central incisor's rotation, (3) correction of maxilla midline, (4) formation of the correct overjet and overbite, (5) and leveling and alignment of entire dentition. Bleaching of the maxillary right central incisor was also planned for recovering esthetics.

### 3. Treatment alternatives

Endodontic treatment of the maxillary central and lateral incisors was planned for removal of the infection caused by the cyst, followed by cyst enucleation, apicoectomy, and retrofilling. Two options were suggested to establish the orthodontic treatment objectives and resolving the chief complaint:

1. Leveling and alignment of the entire dentition.
2. Anterior alignment and establishment of the correct anterior relationship using passive bracketing on the posterior dentition over a short treatment period.

The patient was 36 years old and had an active social life, so he requested treatment times as short as possible. The second of these two options was selected in consideration of that request.

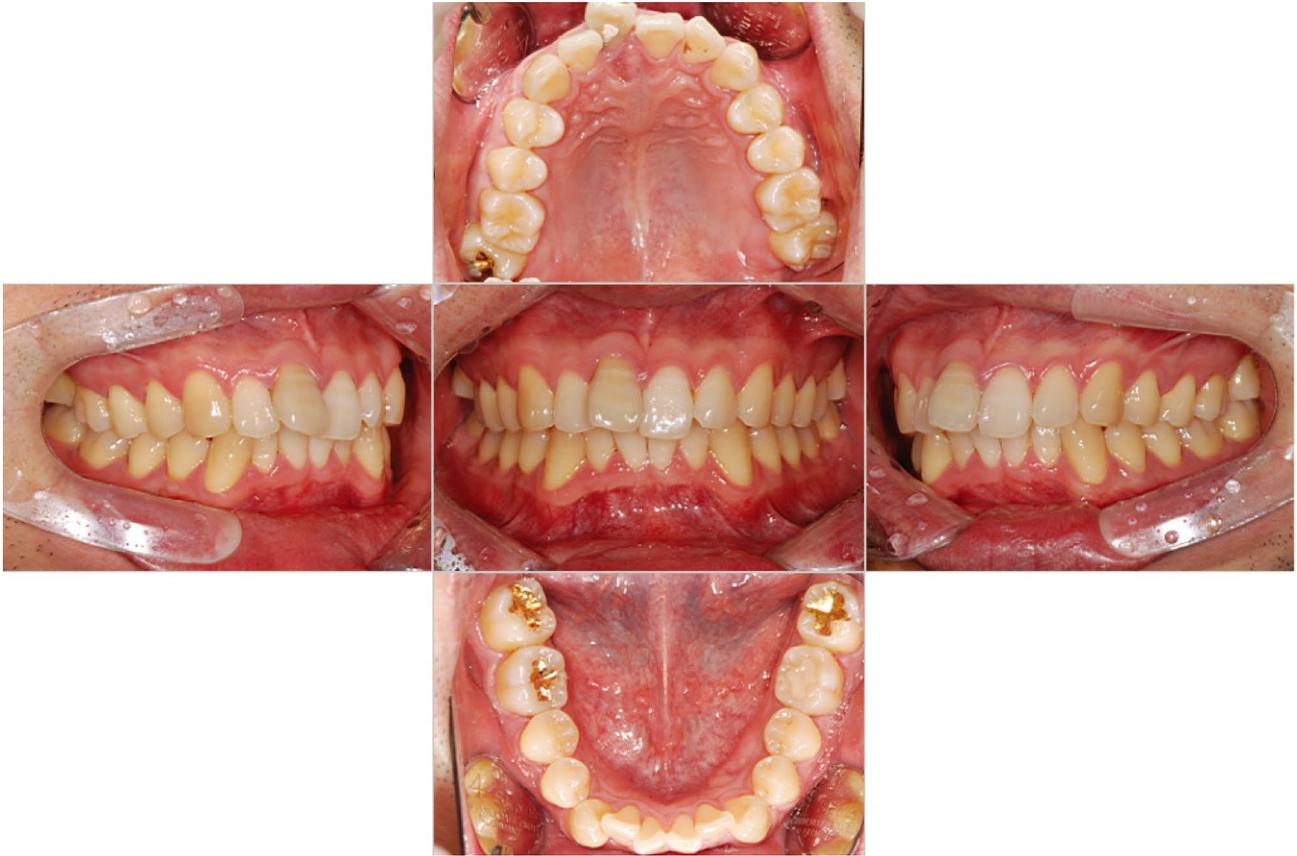


Figure 1. Pretreatment intraoral photographs. Discoloration of #11 and minor crowding on anterior region were observed.

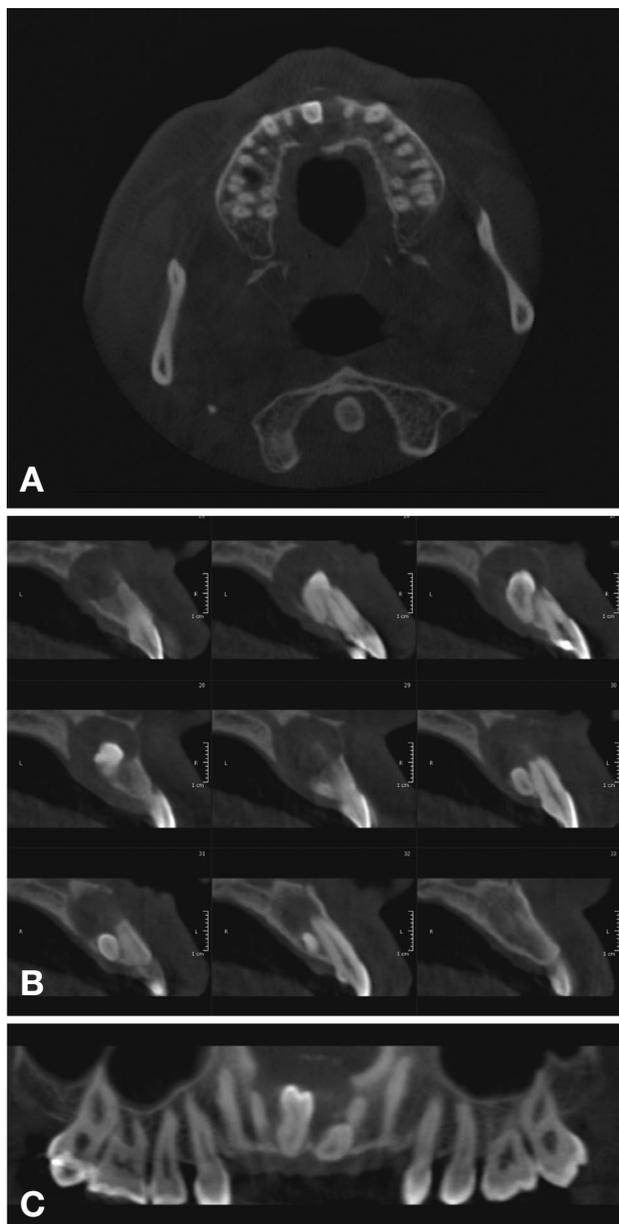


Figure 2. Pretreatment panoramic radiograph. SNTs and radiolucent lesion in the apex of maxillary central incisor were observed.

#### 4. Treatment plan

Scaling for oral hygiene was planned as the first treatment step, followed by endodontic treatment of the four maxillary

anterior teeth, cyst enucleation, removal of the SNT, apicoectomy, and retrofilling of the four maxillary anterior teeth. After surgery, orthodontic treatment designed to resolve the anterior crowding was planned, together with bleaching of



**Figure 3.** Pretreatment computed tomography. SNTs were located in palatal side (A: axial view, B: cross sectional view, C: panoramic view).

the maxillary right central incisor.

### 5. Treatment progress

After an oral examination, scaling and endodontic treatment of the maxillary central and lateral four incisal teeth were performed. In order to prevent reinfection from the cyst, cyst enucleation was performed with removal of the SNT the next day after endodontic treatment. The cyst enucleation and

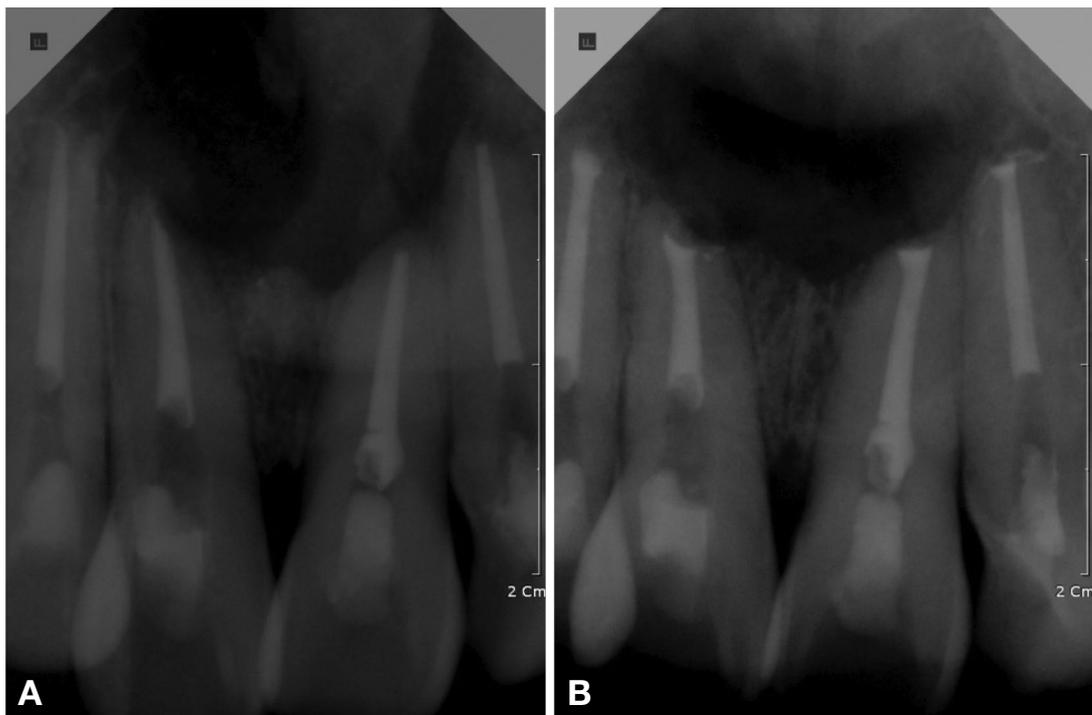
retrofilling of the four incisal teeth were conducted during the same surgery, and overfilling was performed for complete apical sealing. First, two vertical incisions were made in the mesial area of the left and right first premolars for maintenance of interdental papillae, and a flap was reflected to completely expose the superior margin of the cyst, which was carefully dissected along its margins. On completion of the dissection, the cyst was separated from the maxilla and extracted; the SNT were found within the cyst (Fig 4). Examination of a biopsy specimen of the removed soft tissue identified the cyst as a nasopalatine duct cyst. The cyst was not caused by the incisal teeth; however, the proximity between the cyst and root apices rendered it possible that expansion of the cyst could induce external root resorption of the central incisors and retroinfection of the lateral incisors. Therefore, root apicoectomy and retrofilling with mineral trioxide aggregate (MTA) were performed for the four incisors. As a result of bone resorption, left and right central incisors exposed to the roots, and external absorption was observed in the left and right incisors.

Overfilling with gutta-percha bone made it easier to check the location of the root apices. Periapical radiographs were obtained after apicoectomy and retrofilling (Fig 5), and the cavity caused by bone resorption was filled atelocollagen sponge (Teruplug, Olympus Terumo Biomaterials, Japan), and the flap closed and sutured.

Periapical radiographs were obtained 2 months after surgery to evaluate the recurrence of the cyst. Orthodontic treatment was started 2 months later, after the patient's symptoms had disappeared and the healing process appeared normal. The left and right canines and molars had class I occlusion, and the patient had a normal profile. At the request of the patient, the initial orthodontic treatment objective was set to resolution of his upper anterior crowding. However, there was concern that the existing overjet (3.0 mm) and overbite (3.5 mm) would be exacerbated if only the maxillary anterior teeth were realigned and leveled, and so the decision was made to proceed with realignment of both the upper and lower arches. The patient's main problems were (1) anterior crowding, (2) rotation of the maxillary right central incisor, (3) an abnormal sum of incisors (upper arch:lower arch, 4:2.88), and (4) maxilla midline deviation to the right side (1 mm). The ALDs in the maxilla and mandible were 3.8 and 3.3 mm, respectively. Therefore, interproximal stripping of 3 mm was planned for each of the six anterior teeth in the maxilla and mandible, and some arch expansion was expected. Self-ligation brackets (Clippy-C, Tomy, Japan) were used to reduce the frictional



**Figure 4.** A. A cyst was observed in the region of teeth #11 and #21 after raising a buccal mucoperiosteal flap. B. Extended osseous defect after cyst removal. C. The removed cyst and SNT.



**Figure 5.** A. Periapical radiograph obtained after apicoectomy. B. Periapical radiograph obtained after retrofilling.

force during sliding.

Indirect bracket bonding was initially performed in the maxilla. Passive bracketing was applied to the posterior teeth, and 014 NiTi wires were inserted for all except the maxillary right central incisor. Stripping of the six upper anterior teeth was planned to produce the correct overjet and overbite. However, the distal surface of canine was addressed first, because the irregular alignment and leveling of the other teeth rendered it difficult to perform correct stripping. The patient attended follow-up visits at 4-week intervals, at which indirect bracket bonding was applied to the mandibular and

maxillary right central incisors, with 014 NiTi, 016 NiTi, 018 NiTi, 016 SS, 016 × 022 NiTi, and 016 × 022 SS wires being used with stripping to relieve the crowding.

In the final stage of the treatment, about 8 months after the initial surgery, nonvital bleaching with sodium perborate was performed on the maxillary right central incisor. Before bleaching, the target tooth had a shade of A3 (the shade of the adjacent teeth was A2). Nonvital bleaching was overbleached in case the shade could be dark later. After completion of orthodontic treatment, lingual fixed retainer was attached to the maxillary and mandibular canine to canine (Fig 6). Individual



Figure 6. Posttreatment intraoral photographs.



Figure 7. Posttreatment radiographs obtained at 42 months after surgery.

trays were manufactured for home bleaching of the entire dentition.

The root surface of the maxillary incisor was found to be well covered with the lamina dura. And complete healing was

confirmed in periapical radiographs obtained 8 months after orthodontic treatment, and again 3.5 years after the initial surgery (Fig 7).

## DISCUSSION

In this case, functional and esthetic recovery was achieved via a multidisciplinary approach that included cyst enucleation, apicoectomy, orthodontic treatment, and bleaching.

Research has continued to reduce the period of orthodontic treatment required to achieve esthetic satisfaction in many adult orthodontic patients, who tend to desire a satisfactory appearance both during and after orthodontic treatment. Corticotomy can reduce the orthodontic treatment period to allow rapid movement of the teeth by artificial perforation of the cortical bone. This technique was first introduced in 1959, and speeded up the orthodontic treatment by making each tooth a “bony block.” This was achieved by making horizontal cuts in the root apex area that were connected to vertical cuts in interproximal area, thus eliminating the continuity of the cortical bone<sup>1</sup>. Ongoing research into corticotomy-facilitated orthodontics has now demonstrated that the cause of the rapid tooth movement resulting from this corticotomy procedure is not breaking the continuity of the cortical bone, but rather the regional acceleratory phenomenon (RAP), defined as the amplification of local healing, which increases the bone turnover when a temporary tooth is adjacent to the cortical injury<sup>2</sup>. Some recent research and case reports have shown that the RAP also occurs following minimally invasive methods using piezoelectric surgical devices<sup>3</sup>. This phenomenon was observed as early as 10 days after surgery in animals, with the alveolar bone recovering within 120 days after surgery; however, Yaffe et al. found that RAP in humans begins within a few days of surgery, peaks at 1~2 months, and may take from 6 to even >24 months to subside<sup>4</sup>.

In the patient described herein, additional bone reduction was necessary after cyst enucleation, for apicoectomy. Although the healing range by cortical bone reduction was limited in the apical portion compared to that achieved with artificial apicoectomy, it served as an inducer of the RAP, making tooth movement easier by improving the bone turnover. Therefore, it appears desirable to commence orthodontic treatment within 1~2 months after such surgery, at which time the RAP is peaking. However, in this case orthodontic treatment was delayed by 2 months after the surgery due to incomplete soft tissue healing and to ensure there was no cyst recurrence (although the risk of that was low)<sup>5</sup>. The shorter root (after apicoectomy) could have eased and speeded up the orthodontic movement because the resulting shift of the center of resistance of the tooth had moved it to the coronal portion.

Nasopalatine duct cysts are the most common nonodontogenic cyst, with a prevalence of 73%<sup>6</sup>, and occur more frequently in men than in women<sup>7</sup>, with a mean patient age of 42.5 years<sup>11</sup>. It is widely accepted that they are created as a result of proliferation of the epithelial remnant of the embryologic nasopalatine duct<sup>5,7</sup>. The most common symptom is incisive papilla swelling, and only 13~50% of patients have other symptoms, including swelling and fistula<sup>5,7,8</sup>. The appropriate treatment for large cysts is to remove the entire structure; however, a differential diagnosis is required to distinguish these cysts from odontogenic keratocysts or lesions of apical portion and, if there are SNT, from dentigerous cysts<sup>9</sup>.

At the first visit of the present patient, nasopalatine duct cyst was considered due to its heart shape on panoramic radiography; however, a differential diagnosis was necessary to rule out a dentigerous cyst due to the presence of SNT in the apex area of the maxillary central incisor. A dentigerous cyst was ruled out on periapical radiography, since it was separated from the crowns of the SNT. Finally, the diagnosis of a nasopalatine duct was confirmed by examination of an excisional soft-tissue biopsy sample. This cyst had resulted in slight swelling on the palatal area and loss of vitality of the maxillary right central incisor, and had expanded sufficiently to dissolve the buccal and lingual cortical bone, as evidenced on computed tomography. Thus, cyst enucleation was decided.

The observed infection originated from the cyst, not from the tooth pulp. Although it was not in contact with the root apex of the lateral incisor, the cyst was close to the apex of that tooth and so there was a possibility of pulp infection. Therefore, an apicoectomy was performed followed by retrofilling of the four incisors with a view to removing the source of the infection in the pulp chamber. If the root-canal treatment had been performed for those teeth prior to cyst removal, it would have been done so in the presence of bacteria, and it would have been difficult to complete apical sealing due to bacterial effusion within the cyst. Even if apical sealing had been completed, the long period of time between the two procedures would have increased the probability of reinfection in the pulp chamber from the cyst; the best course of action would therefore have been to perform both procedures together in one operation. However, that would have been a burden to both the dentist and the patient. Thus, a compromise was to proceed with the two procedures sequentially with a short interval. By choosing this method, the flow pathway in the root canal was blocked to reduce the

possibility of reinfection. In addition, the root canal treatment was conducted within a short time and overfilling of 3~4 mm was performed intentionally, conferring excessive pressure to obtain a better apical seal from the cyst present in the apical portion, and to reduce the difficulty of the procedure.

In principle, the apicoectomy procedure requires resection of the root apex along its long axis in the vertical direction. However, in the present case the visibility and instrumentation access were both poor due to the lingual inclination of the roots of the maxillary incisors. It is well known that MTA is an excellent material for retrofilling of roots, and it is minimally toxic, odontogenic, and cementogenic. However, MTA is difficult to handle and it can be easily washed away, and so bleeding control is particularly important; epinephrine pellets, collagen substances, and bone wax can be used for hemostasis. In the present patient, skillful handling of the MTA was needed because the exposed areas were wide and four teeth were being treated simultaneously.

The materials used for teeth bleaching degrade the effectiveness of the adhesive used for orthodontic bracket bonding<sup>10</sup> due to the presence of residual oxygen generated during bleaching treatment. The brackets should thus be bonded 2~3 weeks after bleaching<sup>11</sup>, when that oxygen is depleted, or else the bleaching could be performed after the orthodontic treatment. The cause of the tooth discoloration, the speed and duration of the color change, and the degree of color change should be ascertained prior to bleaching, because these influence the results of the bleaching process, and the prognosis. The success rate of bleaching tooth discoloration due to pulp necrosis is reportedly >95%, unlike that due to drugs or filling materials such as metal amalgam restorations<sup>12</sup>. Therefore, a strong bleaching effect was expected in this patient because the tooth color had changed gradually and the cause of the discoloration was pulp necrosis.

Nonvital bleaching confers satisfactory results in the short term, but other studies have found the success rate of treatment and satisfaction level of patients to be <50%, due to increasingly dark-colored teeth<sup>13</sup>. Therefore, overbleaching (i.e., whitening so that the color of the bleached tooth is whiter than the adjacent teeth) is often applied<sup>14</sup>. Overbleaching was conducted in the present patient, and this provided satisfactory results.

The satisfaction of the individual patient is subjective. In addition, the oral condition differs between individual patients, and so treatment for esthetic results is complicated and difficult. It is necessary for the dentist to understand the importance of the esthetics to the individual patient, and to pres-

ent a suitable method for their treatment, in order to establish a reference against which to evaluate the esthetic objective. Esthetic assessment methods can be divided into three types according to their perspective: extraoral (dentofacial assessment), intraoral (dental assessment), and gingival<sup>15</sup>. Dentofacial assessments include the incisal seen at rest and the dental midline and incisal line seen when smiling; intraoral assessments include labiolingual inclination of the maxillary central incisors, teeth alignment, and tooth contour, proportions, and shade<sup>15</sup>. These processes are sometimes accompanied by prosthetic treatment, orthodontic treatment including intrusion and extrusion, perioplastic surgery for harmonious gingival levels, orthognathic surgery, bleaching, and endodontic treatment. Consideration of these factors may necessitate the involvement of a multidisciplinary team of many specialists in order to achieve a high level of dental care.

The present patient submitted to multiple treatments, including endodontic treatment, cyst enucleation, apicoectomy, retrofilling, orthodontic treatment, and bleaching in a limited, anterior maxillary portion, which resulted in resolution of his pain, functional restoration, and a high level of esthetic satisfaction. This case report demonstrates that a precise diagnosis before treatment and a multidisciplinary approach can lead to appropriate treatment results in a patient with dental disease and esthetic dissatisfaction.

## CONFLICTS OF INTEREST

The authors have no conflicts of interests in this study.

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