An orthodontic approach for Class III malocclusion in a pediatric cancer patient: A case report

Jae-Hwan Kim¹, Myeongkwan Jih^{2*}

¹Department of Pediatric Dentistry, School of Dentistry, Chonnam National University, Gwangju, Korea

²Department of Pediatric Dentistry, School of Dentistry, Chosun University, Gwangju, Korea

Leukemia is a cancer that arises in the hematopoietic system, and the most common leukemia in children is the acute lymphoid leukemia (ALL). However, modern advances in therapeutic approaches have greatly increased the chances of survival. As the number of survivors of childhood cancer increases, more patients with cancer history seek orthodontic treatment. Certain dental conditions may require modifications to general orthodontic care in order to reduce or prevent adverse treatment outcomes in patients with histories of cancer, but orthodontic training courses do not often cover these specific aspects. The objective of this case report was to discuss the complications of chemotherapy related to dental development and document the outcomes of a first-phase orthodontic treatment of Class III malocclusion in a pediatric patient with a history of ALL.

Key Words: Child, Malocclusion, Neoplasms, Orthodontic, Precursor cell lymphoblastic leukemia-lymphoma

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INTRODUCTION

Leukemia is a cancer that arises in the hematopoietic system. The disease can be subdivided based on clinical course into acute and chronic types, and based on primary lineage into myeloid and lymphoid types [1]. The most frequent form of leukemia found in children is acute lymphoid leukemia (ALL) [2]. The disease accounts for about 80% of all leukemic malignancies in childhood, with the peak incidence at 3 to 4 years of age [3]. Modern advances in therapeutic approaches have greatly increased the chances of survival, so medical specialists must give more attention to treating long-term survivors [4].

Although successful outcomes after cancer therapy are increasing, cancer treatments can negatively influence the development of cranial bones, cervical vertebral bodies, and oral cavity structures such as teeth and jaws. Frequent complications of cancer therapy with respect to dental development include arrested root development, disturbances in enamel mineralization, microdontia, hypodontia, and premature apical closure [5].

As the number of survivors from childhood cancer increases, more patients with cancer history seek orthodontic treatment. Certain dental conditions may require modifications to general orthodontic care in order to reduce or prevent adverse treatment outcomes. However, orthodontic

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Corresponding author: Myeongkwan Jih, Department of Pediatric Dentistry, School of Dentistry, Chosun University, 309 Pilmun-daero, Dong-gu, Gwangju 61452, Korea.

Tel: +82-62-220-3868, **Fax:** +82-62-225-8240, **E-mail:** mdenti@chosun.ac.kr

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training programs often do not emphasize information on orthodontic treatment for patients with a childhood cancer history [5].

The American Academy of Pediatric Dentistry (AAPD) [6] recommends that orthodontic care be started or resumed after at least two disease-free years post-completion of cancer therapy, after which the risk of relapse is lower. However, detailed guidelines for orthodontic care in pediatric cancer patients, including the optimal force and the pace of orthodontic therapy, remain undefined [7].

The purpose of this case report was to delineate dental developmental complications of chemotherapy and document outcomes of first-phase orthodontic treatment in a pediatric patient with a history of ALL.

CASE

A 7-year-old boy visited the Department of Pediatric Dentistry at Chonnam National University Dental Hospital with the chief complaint of anterior crossbite. The patient's medi-

cal history included ALL. Treatment for leukemia was initiated at the age of 2 years, and the duration of treatment was 1 year.

Clinical and radiographic examinations revealed a Class

Fig. 2. Lateral cephalogram of the patient at first visit for the orthodontic consultation.

Fig. 1. Extra-oral (A-C) and intra-oral (D-G) photos of the patient at the first visit for the orthodontic consultation. Note concave profile and anterior crossbite.

III molar relationship, an overbite of 3.5 mm, and an overjet of -2 mm. The lateral profile was concave with anterior crossbite (Fig. 1, 2). The patient's uncle on the mother's side had undergone a two-jaw surgery, and his mother's facial profile was also concave. At the age of 5 years, he had received orthodontic treatment using a face mask with a rapid palatal expander (RPE) for 9 months, and anterior crossbite had been resolved. Nonetheless, anterior crossbite had reappeared during the period of a long-term broken appointments. No negative complication resulting from cancer therapy was seen in the oral cavity, but the lower second premolars and the second molars were smaller in coronal size in comparison to the first molars and the adjacent premolars (Fig. 3).

The treatment plan was to use the face mask with RPE, and then to use a full-bonding bracket system. However, the patient was diagnosed with a relapse of leukemic malignancy, and orthodontic treatment was delayed until the patient's condition was stable.

After 4 months of cancer therapy and a 5-month maintenance period, laboratory results returned to normal and a good systemic condition was established. RPE and face

mask were delivered to the patient (Fig. 4). Conventional instructions regarding the use of the appliances were provided following: turning the expansion screw once a day for 2 weeks and wearing the face mask every day for a minimum of 10 hours.

Eight months later, the RPE was removed due to mobility in the maxillary primary first molars (Fig. 5). The anterior crossbite had resolved except for the maxillary right lateral incisor. A removable appliance with a finger spring was fabricated to correct the tooth position (Fig. 6).

A sagittal II appliance with a spring was fabricated and delivered to acquire space for the upper canines. Sagittal II appliances were changed four times over a 16-month period in order to replace the screw, to replace a lost appliance, and to provide a better fit of the appliance (Fig. 7).

At the end of the first-phase orthodontic treatment with removable appliances, the patient's profile had improved, and anterior crossbite as well as crowding had resolved (Fig. 8, 9). Several cephalometric indicators were improved (Fig. 10, 11). The A point, nasion, B point angle (ANB) had increased from -0.5° to 1.5° , and Wits appraisal had changed from -6.0 mm to -4.0 mm. Anterior dysplasia indicator

Fig. 3. Panorama image of the patient at first visit for the orthodontic consultation.

Fig. 5. Panorama image of the patient after rapid palatal expander removal. Space for the maxillary canines is insufficient.

Fig. 4. Intra-oral view of the rapid palatal expander appliance with hooks from face mask.

Fig. 6. Delivery of removable spring appliance.

Fig. 7. Delivery of sagittal appliance with finger spring.

(ADPI) values had improved from 90.0° to 86.0° (Table 1).

Oral complications from chemotherapy in this patient included microdontia and root thinning. The coronal widths of the maxillary second premolars and the mandibular second molars were far less than the average according to Korean standards [8]. Fortunately, the patient's systemic medical status was fine, and side effects on oral tissues were not seen during the orthodontic interventions. The

patient did not have any discomfort wearing removable appliances and showed good compliance.

DISCUSSION

Patients with a history of pediatric cancer require extensive consideration when dental treatment is planned. Complications found in pediatric cancer patients can result

Fig. 8. Extra-oral (A–C) and intra-oral (D–G) photos of the patient at the end of the first-phase orthodontic treatment. Anterior crossbite has been resolved, and a space required for the maxillary canines is sufficient.

Fig. 9. Panorama image of the patient at the end of the first-phase orthodontic treatment.

directly from the disease itself or from the effects of radiation and chemotherapy [9].

Complications of cancer therapy related to dental development include arrested root development, disturbances in enamel mineralization, microdontia, hypodontia, and premature apical closure [5]. The patient's age at the time of the initial treatment is an important factor in the development and the degree of adverse effects in the oral cavity

Fig. 10. Lateral cephalogram of the patient at the end of the first-phase orthodontic treatment.

[10]. Long-term survivors have a particular risk of complications during the course of orthodontic treatment due to disturbances in dental development and craniofacial skel-

Fig. 11. Superimposition of lateral cephalometric measurements. Anterior crossbite has been resolved with improved esthetic line (black: before, red: after).

eton growth. As knowledge of these risk factors is essential, a dental clinician must be aware of the previous treatment history and its effects on the orthodontic treatment plan [5].

da Fonseca [7] has argued that fixed orthodontic appliances or space maintainers must be removed if the oral hygiene in the patient is compromised and if the treatment has a high risk of development of mucositis. To provide further orthodontic care for these children and adolescents, the orthodontist must check for signs of gingival oozing, hematomas, petechiae, ulcerations, gingival hypertrophy, pain, and inflammation in the pharynxes and lymph nodes [11]. Barbería et al. [12] have suggested that, in a patient preparing for an active cancer treatment, fixed appliances with brackets, bands, or lingual arches can be applied if the patient tolerates the equipment and if no sign of irritation of the mucous membrane is seen. Additional recommended strategies in the orthodontic treatment of pediatric cancer patients are as follows: (1) use appliances that cause the least risk of root resorption, (2) use light forces, (3) finish treatment earlier than usual, (4) adapt the simplest method, and (5) do not treat the mandible [13].

The patient in the present case received additional chemotherapy after the orthodontic diagnosis was made due to a relapse of leukemic malignancy. It was fortunate that the extent of relapse was very limited, allowing him to receive limited chemotherapy only. The patient recovered in

Table 1. Comparison of the cephalometric values before and after the treatment

Measurement	Norm	Treatment	
		Before	After
SNA (°)	81.0	80.0	82.5
SNB (°)	78.0	80.5	81.0
ANB (°)	3.5	-0.5	1.5
FMA (°)	26.5	26.0	29.5
SN-MP (°)	36.0	29.5	30.5
U1/SN (°)	105.5	106.0	119.5
U1/NA (°)	24.5	22.0	34.0
L1/NB (°)	30.0	22.5	25.0
IMPA (°)	96.0	90.0	91.5
Interincisal angle (°)	122.0	134.5	118.5
UL to E-line (mm)	2.5	0.0	1.0
LL to E-line (mm)	4.0	2.0	2.0
L1 to Pog (mm)	3.0	7.5	4.5
U1 to A-Pog (mm)	7.0	2.0	7.5
L1 to A-Pog (mm)	3.5	5.0	6.5
A-B plane angle (°)	-6.0	-1.0	-4.0
APDI (°)	81.5	90.0	86.0
Wits (mm)	-2.0	-6.0	-4.0

ANB, A point, nasion, B point angle; ADPI, anterior dysplasia indicator.

a comparably short time. Since no major cancer treatment was administered and no negative hematologic signs were observed, planned orthodontic treatment began with minimal delay. A face mask with RPE was successful in improving maxillary retrusion. Sequentially removable appliances were used, primarily to resolve a lack of space and secondarily to guide single teeth to normal positions. Adequate space for canines was acquired successfully. No complication or discomfort due to orthodontic devices or treatment processes were observed. The AAPD recommends waiting for a period of two disease-free years before initial orthodontic treatment. Our patient received orthodontic intervention after only 5 months of disease-free period but did not show any negative effects of the use of orthodontic appliances. Treatment with removable appliances showed reasonable treatment outcomes in this patient with no side effects on the roots of teeth and soft tissue. This may be due to limited growth of cancer cells and to less extensive cancer therapy. However, clinicians must be aware of the extent of cancer growth and the course and intensity of the cancer treatment.

Before beginning any therapeutic intervention, pediatric

dental specialists should gather information on the underlying disease, time of the diagnosis, treatment modality, and complications, including cancer relapse. Providing optimal care and proper adjustment during orthodontic management can lead to successful treatment and improve quality of life in cancer survivors.

Pediatric cancer patients have a better chance of survival due to recent advances in cancer therapy. Survivors of antineoplastic treatment often suffer from side effects in the oral cavity. Despite possible complications, the first-phase treatment of a dental Class III patient with ALL was successful via the use of face mask with RPE, spring appliances, and sagittal appliances. Before beginning the actual intervention, clinicians must examine the medical records of the patient thoroughly and special care must be taken to prevent any further discomfort or negative consequences due to the side effects of cancer treatment.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

ORCID

Jae-Hwan Kim

<https://orcid.org/0000-0001-8088-6216>

Myeongkwan Jih

<https://orcid.org/0000-0001-9579-076X>

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