

THE EFFECT OF HYPERTHYROIDISM ON THE RATE OF ORTHODONTIC TOOTH MOVEMENT

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Abstract

There are various local and systemic factors which alter the rate of tooth eruption movement. Thyroid hormone has been reported to have proportional relationship with the rate of tooth eruption. The main function of thyroid hormone is the regulation of basal metabolism, but it also affects the rate of tooth eruption.

In this report, we will present a case of an 11-year-old girl, who showed sudden increase in orthodontic tooth movement of the impacted canine at certain points, which coincided with the hyperthyroid period. It shows possible relationship between the serum level of thyroid hormone and the rate of orthodontic tooth movement.

Key words : Thyroid hormone, Rate of tooth eruption, Orthodontic tooth movement

I . Introduction

The main function of thyroid hormone is to regulate the basal metabolic rate of human body. It controls the metabolism of organic tissues through 2 types of nuclear receptors (TR α , TR β), which influence on the cellular turnover rate^{1,2)}. It has profound effect on metabolism of not only soft tissues but also hard tissues³⁻⁵⁾.

Thyroid hormone is also known to influence the eruption rate of teeth. Early eruption and premature shedding of deciduous dentition, followed by accelerated emergence of permanent dentition, have been reported in children with hyperthyroidism⁶⁾. On the contrary, delayed eruption of teeth has been reported in children with juvenile cretinism as well as in animal models which received thyroidectomy or anti-thyroid drug administration⁷⁻¹⁵⁾.

In several clinical and animal studies, the administration of a low dosage of thyroxine enhanced the rate of orthodontic tooth movement with decreased extent of root

resorption¹⁶⁻¹⁸⁾.

The aim of this report is to present a case where increased rate of tooth movement during the forced eruption procedure was observed in a young girl in correlation with the high level of serum thyroid hormone.

II . Case Report

An 11-year-old girl came to the department of pediatric dentistry, Yonsei University Dental Hospital, for evaluation and treatment of the unerupted upper left canine. Radiographic examination revealed ectopic eruption pathway of the upper left canine tilted toward the labio-mesial aspect(Fig. 1). The active orthodontic procedure, including forced eruption, took 21 months, and relatively fast tooth movement was observed at certain periods. During the finishing phase of the upper arch using a rectangular heavy wire, progressive generalized spacing appeared in the lower dental arch, which was an unexpected phenomenon. In order to clarify the possible

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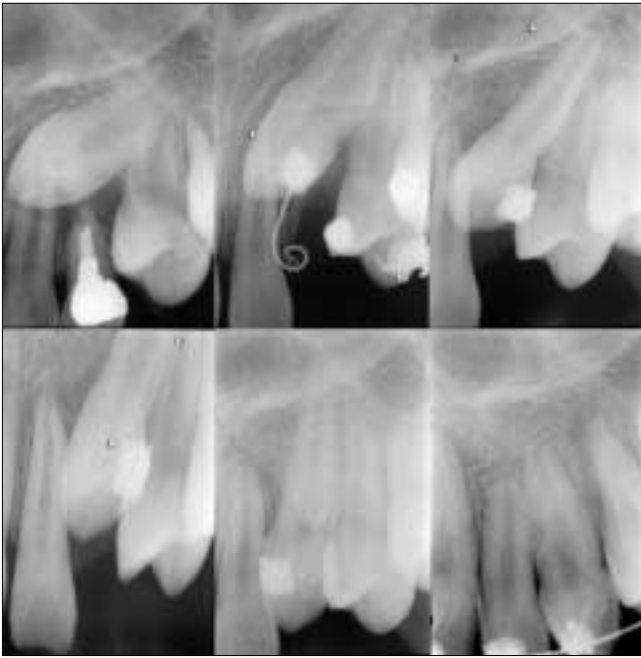


Fig. 1. Consecutive periapical radiographs showing tooth movement of the upper left canine during orthodontic treatment using forced eruption procedure.

causes of generalized spacing in the mandible, her medical history was reviewed. Then, it was found that she had been diagnosed as primary hyperthyroidism after 13

months since the initiation of forced eruption procedure.

According to her medical records at Yonsei University Medical Center, high level of thyroid hormone, especially T3, was detected in her serum hormonal immunoassay. Antithyroid drug, propylthiourasil(PTU), was prescribed to control serum thyroid hormone, along with beta-blocker, propranolol(Inderal®) to control tachycardia caused by hyperthyroidism. Pharmacotherapy was effective that serum level of T3 and T4 decreased markedly as the serum level of TSH increased (Fig. 2). Medical treatment at the endocrinology department was terminated around the same time as the orthodontic treatment was completed. Since then, she has maintained euthyroid state.

1. Analysis of case

Since the orthodontic movement of the impacted tooth was considerably fast, its rate was analyzed in comparison with the serum level of thyroid hormones at the same point. Eruption rate was calculated using periapical radiograph taken periodically. Vertical elongation and shortening on the periapical films were compensated proportionally using several landmarks as reference points, such as cusp tips, cervical margins, and root apexes of adjacent teeth.

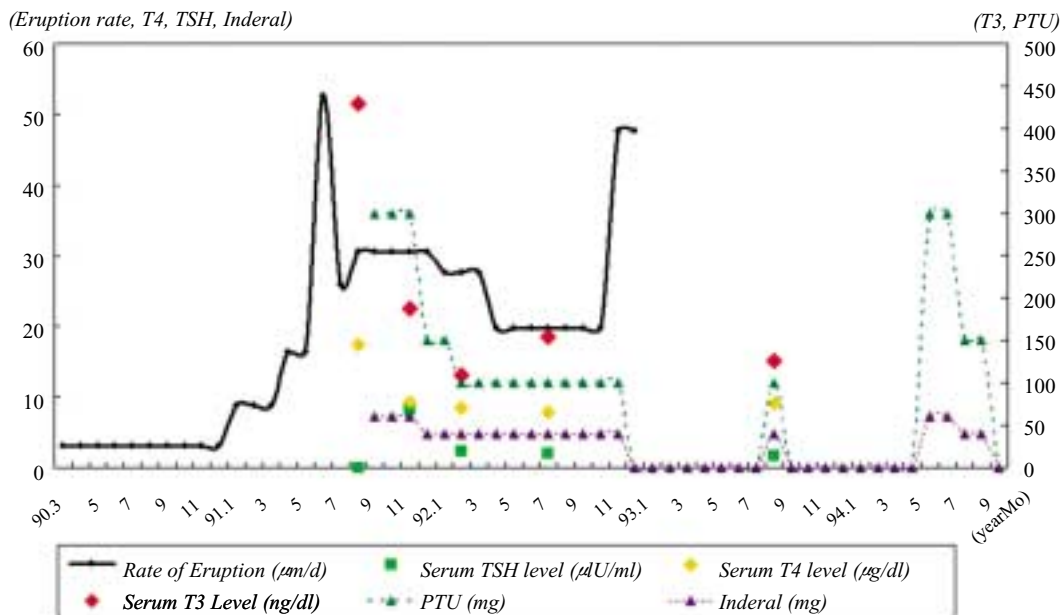


Fig. 2. Graph with double Y-axes, showing changes in the rate of orthodontic tooth movement in comparison with the serum levels of various thyroid hormones and the dose of the prescribed drugs.

2. Results

The relationship among the rate of orthodontic tooth movement, the serum level of thyroid hormones, and the amount of dose of prescribed drug are illustrated in Fig. 2, a graph with double Y-axes. The rate of orthodontic movement of the impacted canine increased as the serum level of T3 and T4 elevated. When it was fastened up to 53 $\mu\text{m}/\text{day}$ (reference range: 33 $\mu\text{m}/\text{day}$), the elevated serum level of T3 and T4 was 429.2 ng/dl (reference range: 70~190 ng/dl) and 17.5 $\mu\text{g}/\text{dl}$ (reference range: 5~12 $\mu\text{g}/\text{dl}$), respectively (Fig. 2). As shown in the graph, the rate of orthodontic movement of the impacted tooth changed in correlation with the serum level of thyroid hormones, especially, T3.

III. Discussion

There are various local and systemic factors which can alter the rate of eruptive tooth movement, such as ankylosis, 21-trisomy syndrome, cleidocranial dysostosis, achondroplastic dwarfism, thyroid disease, pituitary disturbance, and disorders in growth hormone. Among them, hormonal problems have been reported to have proportional relationship with the rate of tooth movement in previous studies^{6-8,10-15,19}. In accordance, this case also confirmed the effect of thyroid hormone on the rate of orthodontic tooth movement.

Mosekilde et al.³ mentioned that not only calcitropic hormones but also thyroid hormones exert profound effects on skeletal growth, maturation, and turnover. He also mentioned the remodeling rate of bone mass in proportion with the level of thyroid hormones, showing the different numbers of resorption lacunae between hyperthyroid and hypothyroid. Hyperthyroidism resulted in the reduced amount of trabecular bone and decreased mean width of cortical bone, marked shortening of the resorptive and formative phases of bone remodeling cycle and enhanced osteoblastic activity with an increased calcification rate of bone.

According to Isaacson et al.²⁰, the proper orthodontic tooth movement would be 1 mm per month, that is about 33 $\mu\text{m}/\text{day}$. In this case, the rate of orthodontic movement of the impacted canine was increased up to about 53 $\mu\text{m}/\text{day}$ during the hyperthyroid period. Then, the rate decreased to 20~30 $\mu\text{m}/\text{day}$ when antithyroid drugs were administered to adjust the level of serum thyroid hormone.

However, after passing through the gingival tissue, the rate of tooth movement accelerated again up to 47 $\mu\text{m}/\text{day}$, despite of the maintenance of normal thyroid hormone levels. Profitt et al.²¹ said that the rate of tooth eruption quickens after the penetration of oral mucosa. The possible reason for such accelerated movement after gingival emergence is because alveolar bone resorption is no longer necessary for eruption of tooth.

Loberg and Engström¹⁶ reported 3 clinical cases where 0.5 mg of T4 was administered daily during intrusive orthodontic procedure. They noted that all patients appeared to benefit from short-term use of the low dose thyroid hormone supplement without any clinical side effects. Based on this clinical result, they suggested that low dose administration of T4 should be considered for specific patients, especially those who begin to show root resorption or have low thyroid function. In contrast, Christiansen²² mentioned that it can be premature to consider human use of thyroxine as means to slow or prevent root resorption.

Newman²³ and Poumpros et al.¹⁷ studied the effects of hormones on root resorption. They concluded that bone resorptive activity is regulated by L-thyroxine, in addition to PTH. The administration of high doses of T4 in rats led to increase in bone resorption, whereas low dose administration led to reduction in periosteal resorption.

Shirazi et al.¹⁸ reported that conduction of 20 $\mu\text{g}/\text{kg}$ T4 can reduce bone density that, in turn, accelerates orthodontic tooth movement while force-induced root resorption is reduced. It appears that T4 administration increased the rate of alveolar bone remodeling, thereby indirectly augmenting orthodontic tooth movement and decreasing force-induced root resorption.

IV. Summary

Various factors have been studied concerning tooth movement. The relationship between the rate of tooth eruption and the level of thyroid hormone has been reported in several studies.

This was a case of an 11-year-old girl, who showed sudden acceleration of orthodontic tooth movement at certain points, which coincided with her hyperthyroid period. It was a clinical case that showed possible relationship between the serum level of thyroid hormone and the rate of orthodontic tooth movement.

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국문초록

갑상선 기능 항진증이 교정적 치아 이동 속도에 미치는 영향

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치아 맹출 속도는 여러가지 국소적 및 전신적 요소에 의해 영향을 받는다. 그 중 갑상선 호르몬은 치아 맹출 속도와 비례적인 관계를 갖는 것으로 알려져 있다. 갑상선 호르몬은 기초 대사율을 조절하는데 있어서 중요한 역할을 하며, 치과 영역과 관련하여 치아 맹출 속도에 영향을 줄 수 있다.

본 증례에서 만 11세 여아의 매복된 상악 견치의 교정적 견인 시 특정 시점에서 교정적 치아 이동이 빠르게 진행되었고, 이는 갑상선 기능 항진증이 나타난 시기와 일치하였다. 이는 혈청 갑상선 호르몬 수치와 교정적 치아 이동 속도 사이의 연관성을 시사한다.

주요어: 갑상선 호르몬, 맹출 속도, 교정적 치아 이동