치의과학 박사학위논문

Morphological relationship analysis of impacted maxillary canines and the adjacent teeth on 3-dimensional reconstructed CT images

상악 매복 견치와 인접치의 형태학적 상관관계 분석 (3 차원 재구성 CT 연구)

2017 년 8 월

서울대학교 대학원

치의과학과 소아치과학 전공

김 유 준

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이 논문을 치의과학 박사학위논문으로 제출함

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2017 년 6 월

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Abstract

Morphological relationship analysis of impacted maxillary canines and the adjacent teeth on 3-dimensional reconstructed CT images

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It is now well-established that morphological anomalies of the maxillary lateral incisors are closely associated with maxillary canine impaction. However, most of these studies were conducted to examine the crown of the teeth erupting into the oral cavity based on the diagnostic casts. So far, not many studies have been conducted to examine the relationship between the root of the maxillary lateral incisor and the impacted maxillary canine. Active studies have been

conducted using 3-dimensional reconstructed CT images in the field of maxillary canine impaction. So, we were able to observe the incisor root and the impacted canine crown using the 3D reconstructed CT images, in which we cannot see on the diagnostic cast.

The aim of this study was to examine whether there is a relationship between maxillary canine impaction and the morphological characteristics of the maxillary dentition, especially the root of the lateral incisor by using the 3D reconstructed CT images.

In this study, we selected only cases with unilateral maxillary canine impaction to compare the morphological characteristics of the dentition on the impaction side and the normal eruption side. The sample size was decided to be 40 by the pilot study. To minimize the bias depending on the sex and the location of the maxillary canine impaction, we selected equal numbers (20) of males and females, and equal cases (20) of buccal impaction and palatal impaction. Under the above conditions, the mean age was 13.5 ± 2.3 years. The multislice spiral computed tomography (MSCT) images of these 40 subjects were converted into 3D reconstructed images using the OnDemand 3D program (Cybermed Co., Seoul, Korea). We acquired the 3D tooth images by eliminating the adjacent anatomical structures. Then we

measured the morphological characteristics of the individual teeth images.

As we expected, there were no statistically significant differences in the morphological characteristics of the maxillary central incisor between the two groups. The length and volume of the maxillary lateral incisor's roots were significantly smaller on the impaction side as compared with the normal eruption side (P=0.001 and 0.006, respectively). The width and volume of the canine's crown was significantly greater on the impaction side as compared with the normal eruption side (P=0.020 and P<0.0001, respectively).

These results might help to prove the hypothesis that the smaller-sized lateral incisor roots and greater-sized canine crowns are the influential etiologic factors in maxillary canine impaction.

Key words : Impacted maxillary canine, Lateral incisor root morphology, Guidance theory, 3D reconstruction CT

Student Number : 2012-30592

CONTENTS

I. INTRODUCTION

Impairments in tooth eruption, such as tooth impaction or ectopic eruption, can occur in all 32 permanent teeth during the period of mixed dentition. The maxillary canines, with the exception of the third molars, are known to be particularly vulnerable to such problems[1-3]. Thus, the prevalence of maxillary canine impaction reaches 1% to 5%[4-7].

To date, multiple studies have investigated the factors involved in maxillary canine impaction. In general, maxillary canine impaction shows a female predilection; it occurs 2-3 times more often in females than in males[8-11]. Moreover, it has been reported that maxillary canine impaction occurs at an incidence 3-6 times higher on the palatal side compared with the buccal side[12-14]. However, contrary reports show that maxillary canine impaction occurs 2-3 times higher on the buccal side compared with the palatal side in East Asians. These reports suggest that the side of impaction varies depending on the ethnic populations[10,15,16].

Studies on maxillary canine impaction have been conducted to examine various causative factors, such as excessive or inadequate space for the eruption of permanent teeth. In 1983, Jacoby[13]

reported that 85% of palatal impactions have sufficient space for eruption and 83% of buccal impactions have insufficient space for eruption, suggesting that excessive or inadequate space for maxillary canine eruption is involved in the position of maxillary canine impaction. Follow-up studies have examined the relationship between maxillary canine impaction and space for eruption[17-19]. Moreover, it is now well-established that morphological anomalies of the maxillary lateral incisors are closely associated with maxillary canine impaction[9,20-23]. Similarly, it has also been reported that there was a significant decrease in the mesiodistal width of the maxillary teeth in patients with maxillary canine impaction[24,25].

Regrettably, no studies have clarified the underlying mechanisms involved in the impaction and eruption of the maxillary canines[2,26-28]. Of the several hypotheses proposed, the most plausible is the guidance theory[10,20], which suggests that impairments occur in the normal eruption of the maxillary canine in patients where the guiding function of the maxillary lateral incisor's root is lost. This leads to speculation that the incidence of maxillary canine impaction would be relatively higher in patients with peg lateralis or missing maxillary lateral incisors. Supporting this theory, studies have been conducted

demonstrating that maxillary canine impaction is associated with the shape of the lateral incisor and inadequate space for maxillary canine eruption. To date, however, few studies have been conducted to examine the relationship between the root morphology of the maxillary lateral incisor and the impaction of the maxillary canine.

As imaging technology progresses, active studies have been conducted using three-dimensional (3D) reconstructed computed tomography (CT) images with a cone beam CT (CBCT) and a multislice spiral CT (MSCT) in the field of maxillary canine impaction. Most of these studies have focused on the characteristics of the impacted canine or the resorption of the adjacent teeth[29-32]. Yan et al[33] reported the association between the maxillary canine's palatal impaction and small lateral incisor through the 3D CT image analysis, but they studied only the crown of lateral incisor and did not include the root.

The aim of this study was to analyze the morphological characteristics of the impacted canines and the adjacent teeth by using the 3D MSCT reconstructed images. In addition, we tried to verify the relationship between the features of the teeth and maxillary canine impaction.

II. MATERIALS AND METHODS

Subjects

This study was approved by the Institutional Review Board (IRB) at the Seoul National University School of Dentistry (IRB No. S-D20120015). We conducted the current study in patients between 10 and 18 years old who underwent orthodontic examinations and were diagnosed with maxillary canine impaction at the Seoul National University Dental Hospital during a 5-year period ranging from July of 2007 to June of 2012. Of these, the patients who underwent MSCT examination for diagnostic purposes were enrolled in the current study. The exclusion criteria for this study were as follows: (1) patients with the presence of congenitally missing or malformed lateral incisors (including peg laterlais or dilacerations); (2) patients in whom the canine is distally impacted towards the first premolar; (3) patients with definitive obstructions (e.g. odontoma or supernumerary teeth); (4) patients with craniofacial anomalies (e.g. cleft lip or palate); (5) patients with several impacted teeth or congenitally missing teeth.

In this study, we performed a subgroup analysis to examine

whether the morphological characteristics of the adjacent teeth had a relationship with maxillary canine impaction; we selected only the patients with unilateral canine impaction on the left or right. Furthermore, to compare the exact shape of the crown and root in every dentition, we excluded the patients where the root of the incisor was resorbed by the impacted canine or was not completed apex. Thus, we attempted to examine whether there were differences in the morphological characteristics of the dentition between the impaction side and the clinically normal eruption side in the same patient.

We were able to obtain 89 patients who satisfied the aforementioned criteria in our database.

3D Assessment

The MSCT images of these subjects were obtained using the SOMATOM Sensation 10 (Siemens AG, Erlangen, Germany) at a slice thickness of 0.75 mm. Then, we converted the CT DICOM (digital imaging and communication in medicine) images into 3D reconstructed images using the OnDemand 3D program (Cybermed Co., Seoul, Korea). Radiodensity was set-up between +1000 and

+3000 in the Hounsfield unit (HU) scale. If HU is designated as a certain value, the reconstructed images are insufficient to reproduce all the hard tissue of a tooth. Within this range, the image that can express as much hard tissue details as possible was adopted for each patient. Although the HU ranges might vary for each patient, the same HU range was applied to one patient. This variation did not affect to compare the data between the left and right in one patient.

The rare 3D reconstructed images made through this process included both teeth and adjacent hard tissues. We acquired the 3D tooth images only by eliminating the adjacent anatomical structures one by one on the rare reconstructed images (Figure 1a).

With these rare 3D reconstructed images, we acquired the 3D tooth images by eliminating the adjacent anatomical structures (Figure 1a). After removing the premolars and molars, we identified the maxillary central incisors, the maxillary lateral incisors, and the maxillary canines for this study (Figure 1b through 1g).

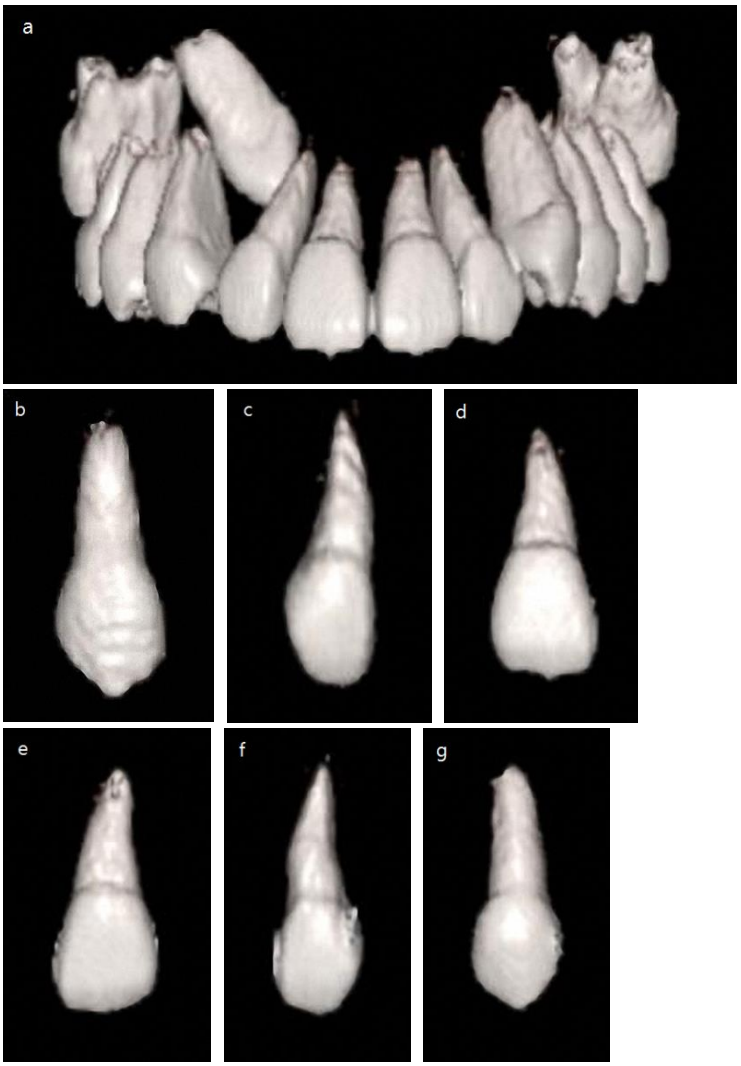

Figure 1. Reconstructed 3D MSCT DICOM images with the surrounding structures removed using the OnDemand 3D program (a). Maxillary right canine separated from the reconstructed 3D image (b). Maxillary right lateral incisor (c). Maxillary right central incisor (d). Maxillary left central incisor (e). Maxillary left lateral incisor (f). Maxillary left canine (g).

As shown in Figures 2 and 3, we measured the following five characteristics in each tooth: (1) mesiodistal width of the crown (mm); (2) anatomical height of the crown (mm); (3) volume of the crown (mm^3); (4) length of the root (mm); (5) volume of the root (mm^3). Then we divided these data into two groups (the impaction-side group and the eruption-side group) in order to compare the data between the two groups.

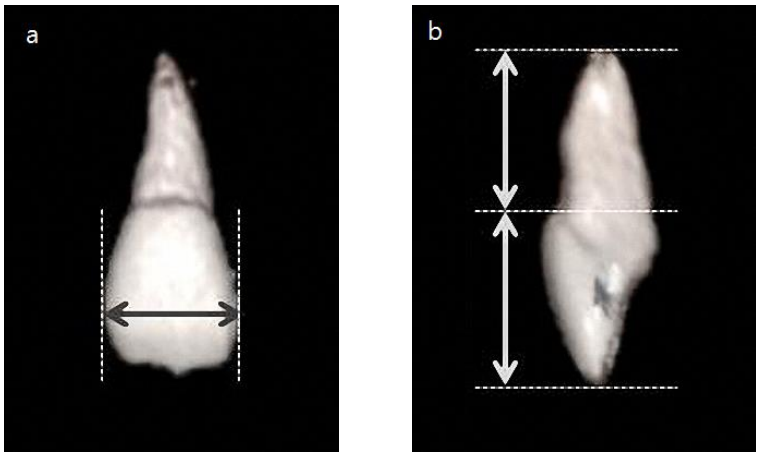

Figure 2. Mesiodistal width of the crown (mm) measured from the widest point of the crown (a). Anatomical height of the crown (mm) measured from the lowest buccal CEJ point to the incisal tip in the lateral view image. Length of the root (mm) measured from the lowest buccal CEJ to the root apex in the lateral view image (b).

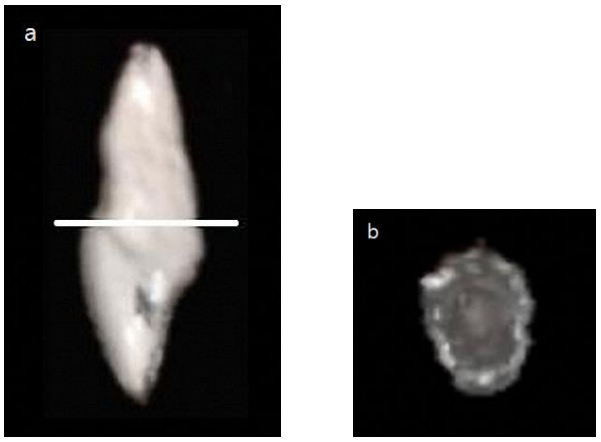

Figure 3. The tooth was separated into the crown part and the root part using a line made by connecting the lowest buccal CEJ and lowest palatal CEJ (a). Then, the crown and root volume were measured using the OnDemand 3D program. This cross-sectional image of the root was obtained by separating the crown and root part (b).

Sample-Size Determination

The pilot study was carried out with 10 patients (5 with buccal impaction and 5 with palatal impaction) according to the same terms and methods. Three categories with expected differences in average value between the two groups were chosen: lateral incisor's length of the root, lateral incisor's volume of the root, and canine's volume of crown.

Three categories were applied to the equation that is a method to calculate the sample size when comparing the mean value of two groups with equal sample numbers. The minimal sample size was 35.5, 38.6 and 29.6 respectively, for each category. Therefore, we decided that 40 should be the sample size in our study (n=40).

In each group, we controlled the factors to minimize the bias depending on the sex and the location of the maxillary canine impaction. Accordingly, we had an equal number of males and females (n=20), and an equal number of cases of buccal impaction and palatal impaction. Under all conditions mention earlier, we randomly selected 40 out of 89 patients. As a result, the mean age of 40 subjects was 13.5 ± 2.3 years, and there were 17 impacted canines on the right and 23 impacted canines on the left.

Statistical analysis

Since the variable distribution of this study does not satisfy the normality, a parametric approach method could not be carried out. Therefore, we used the Wilcoxon signed rank test, which is a nonparametric approach method, in this study. Statistical analysis was performed using SPSS Windows^{TM} version 12.0 software (SPSS Inc., Chicago, Illinois, USA). The level of statistical significance was set at 5%.

III. RESULTS

In this study, intraexaminer agreement was carried out in order to verify the reproducibility of the measurement of all sample values carried out by an examiner in one month after all measurements were made. Since the sample size was 40, total number of teeth measured was 240 (80 central incisors, 80 lateral incisors and 80 canines). Out of 240 teeth, 30 randomly selected teeth (10 central incisors, 10 lateral incisors and 10 canines) were remeasured. Then these values carried out two times were verified using intraclass correlation coefficients (ICCs) (Table 1). The ICC value shows that the intraexaminer reliability is satisfying in all categories.

Table 1. Intraexaminer Agreement Analysis Using Intraclass Correlation Coefficient (ICC)

Measurements		ICC
Central Incisor	Width of the crown (mm)	0.960
	Height of the crown (mm)	0.984
	Volume of the crown (mm^3)	0.952
	Length of the root (mm)	0.960
	Volume of the root (mm^3)	0.956
Lateral Incisor	Width of the crown (mm)	0.964
	Height of the crown (mm)	0.952
	Volume of the crown (mm^3)	0.968
	Length of the root (mm)	0.970
	Volume of the root (mm^3)	0.968
Canine	Width of the crown (mm)	0.927
	Height of the crown (mm)	0.998
	Volume of the crown (mm^3)	0.982

As shown in Figure 4, there were no significant differences in all parameters of the morphological characteristics of the maxillary central incisor between the two groups. There were significant differences in the length (9.77 ± 1.43mm, 10.65 ± 1.12mm) and volume (278.26 ± 51.39 mm^3, 331.32 ± 96.04 mm^3) of the root of the maxillary lateral incisor between the two groups (P=0.001 and 0.006, respectively) (Figure 5). Furthermore, there were no significant differences in any parameters of the crown of the maxillary lateral incisor. In the morphological characteristics of the maxillary canine, the width (8.03 ± 0.80 mm, 7.78 ± 0.61 mm) and volume (626.97 ± 149.24 mm^3, 515.87 ± 136.05 mm^3) of its crown showed a significant difference between the two groups (P=0.020 and P<0.0001, respectively) (Figure 6). However, there was no significant difference in the height (11.11 ± 1.07 mm, 11.30 ± 1.28 mm) of canine's crown.

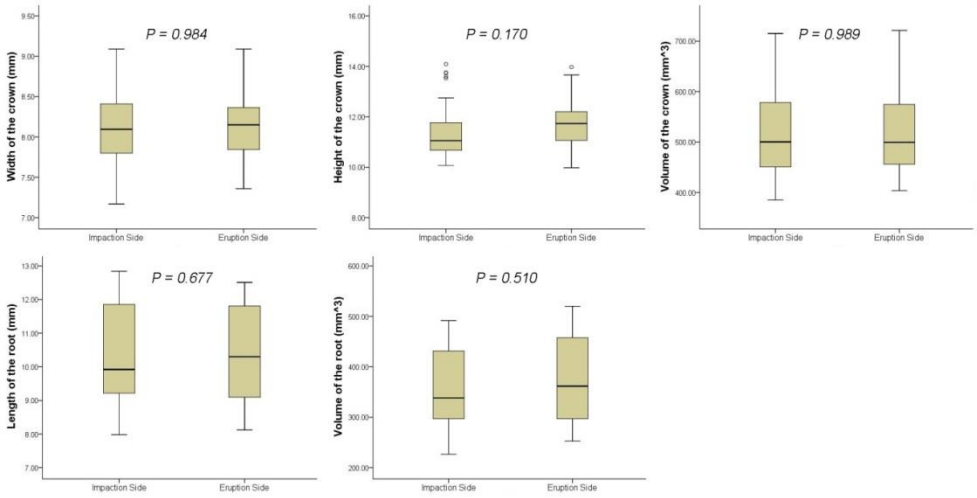

Figure 4. Statistical comparison of central incisors' morphological features between the impaction side group and eruption side group using a Wilcoxon signed rank test.

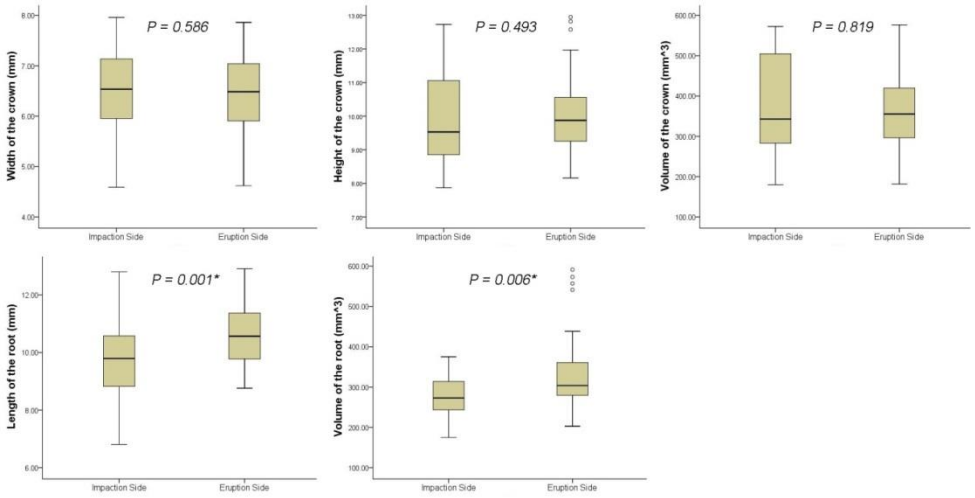

Figure 5. Statistical comparison of lateral incisors' morphological features between the impaction side group and eruption side group using a Wilcoxon signed rank test (*P<0.05).

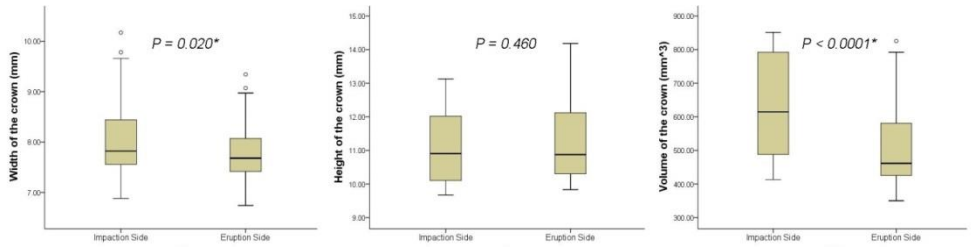

Figure 6. Statistical comparison of canines' morphological features between the impaction side group and eruption side group using a Wilcoxon signed rank test (*P<0.05).

IV. DISCUSSION

In this study, we examined the relationships between maxillary canine impaction and the morphological characteristics of the maxillary central incisor, maxillary lateral incisor, and maxillary canine. There have been previous studies on this topic, but their results are of limited significance in that they analyzed the gross features of the crown based on the diagnostic casts from the impressions. However, in this study, we could examine the shape of the incisors' root and the morphological characteristics of the impacted canine using the 3D reconstructed CT images.

In the process of verifying the intraexaminer agreement, ICC was performed only at the step of measuring the teeth, not at the step of making the 3D images. We obtained the measuring values from both impaction side group and eruption side group in one patient's 3D images. Therefore, ICC in the step of making the 3D images was excluded because it did not affect this comparative study between the two groups.

There were no statistically significant differences in the measurements associated with the morphological characteristics of the maxillary central incisor between the two groups (Figure 4). As

we expected, the shape of the crown and root of the central incisor had no significant correlation with the eruption of the maxillary canine.

Previous studies have shown that anomalies of the maxillary lateral incisors had a significant correlation with maxillary canine impaction[9,20-23]. Moreover, a significant decrease in the mesiodistal dimension of the maxillary teeth, including the maxillary incisors, has also been reported in patients with maxillary canine impaction[24,25]. However, all of these studies were conducted to examine the crown of the teeth erupting into the oral cavity.

Little is known about the precise mechanisms involved in the impaction and displacement of the maxillary canine[2,26-28]. Of the mechanisms proposed, the guidance theory has been accepted as the most plausible explanation. This theory suggests that the root of the maxillary lateral incisor plays an important role in inducing the normal eruption of the maxillary canine. According to this theory, the eruption of the maxillary canine would be deviated if the function of the root of the maxillary lateral incisor was impaired, indicating that the root of the maxillary lateral incisor plays a key role in the eruption of the maxillary canine.

In the current study, we mainly analyzed the differences in the shape of the crown and root of the maxillary lateral incisors between the two groups. Although previously unavailable, it is now possible to examine the shape of the root using 3D-reconstructed CT images. As shown in Figure 5, there were no significant differences in the parameters of the crown of the maxillary lateral incisor between the two groups. However, there were statistically significant differences in the length and volume of the root between the two groups. In other words, although there was no significant difference in the size of the crown of the maxillary lateral incisor between both sides in the same individuals, the root of the lateral incisor had a shorter length and smaller size on the impaction side as compared with the normal eruption side.

Previous studies have presumed that the shape of the root would be small based on the maxillary lateral incisor's small crown size. However, we found differences in the length and size of the root between both the right and left sides in the same individuals regardless of the lateral incisor's crown size. Although this study cannot prove the guidance theory, nor can it prove that smaller roots of the maxillary lateral incisor result in deviations in the eruption of

the maxillary canine, our results are sufficient to suggest that individuals with smaller roots of the maxillary lateral incisor are vulnerable to impaired eruption of the canine.

As shown in Figure 6, our results showed that there was a significant difference in the width and volume of the crown of the maxillary canine between the two groups. In other words, our results showed that the size of the maxillary canine was greater on the impaction side compared with the normal eruption side. Although the result shows that there is a statistically significant difference in the canine width, it is difficult to assign great significance since the actual difference (0.25mm) is smaller than the voxel size (0.75mm). Nevertheless, it is possible to interpret such meaning since the canine crown volume, which is actually more important, showed significant difference. These results suggest that there is a possibility that normal eruption might be impaired due to insufficient space in patients with greater crowns of the maxillary canine, which is consistent with previous reports suggesting that maxillary canine impaction might arise from inadequate space for its eruption[2,13,19].

In actual clinical cases, adequate space needs to be acquired before the orthodontic traction of an impacted maxillary canine is

carried out. Using the aforementioned results, the practitioner needs to think about acquiring more space than the normally erupted canine's mesiodistal size on the opposite arch.

V. CONCLUSIONS

- The length and volume of the maxillary lateral incisor's root were significantly smaller on the impaction side compared with the normal eruption side (P=0.001 and 0.006, respectively), even though no significant differences in the parameters of the crown between the two groups. This indicates that there is a high correlation between maxillary canine impaction and smaller lateral incisor root sizes.
- The width and volume of the maxillary canine's crown was significantly greater on the impaction side compared with the normal eruption side (P=0.020 and P<0.0001, respectively). This indicates that there is a high correlation between maxillary canine impaction and greater crown sizes.

V. LIST OF PUBLICATIONS

This study is based on the following original papers.

- Kim Y, Hyun HK, Jang KT. The position of maxillary canine impactions and the influenced factors to adjacent root resorption in the Korean population. Eur J Orthod 2012;34:302-306.

- Kim Y, Hyun HK, Jang KT. Interrelationship between the position of impacted maxillary canines and the morphology of the maxilla. Am J Orthod Dentofac Orthop 2012;141:556-562.

References

1. Andreasen JO, Petersen JK, Laskin DM. Textbook and color atlas of tooth impactions. 1st ed. Munksguard, Copenhagen 1997:126-166.
2. Becker A. The orthodontic treatment of impacted teeth. 2nd ed. Informa Healthcare, London 2007:93-174.
3. Kung SH, Hwang CJ. Diagnosis and treatment plan of maxillary impacted canine. Korean J Orthod 1993;23:165-177.
4. Thilander B, Myrberg N. The prevalence of malocclusion in Swedish school children. Scand J Dent Res 1973;81:12-21.
5. Ericson S, Kurol J. Radiographic assessment of maxillary canine eruption in children with clinical signs of eruption disturbances. Eur J Orthod 1986;8:133-140.
6. Celikoglu M, Kamak H, Oktay H. Investigation of transmigrated and impacted maxillary and mandibular canine teeth in an orthodontic patient population. J Oral Maxillofac Surg 2010;68:1001-1006.

7. Hou R, Kong L, Ao J, et al.. Investigation of impacted permanent teeth except the third molar in Chinese patients through an x-ray study. J Oral Maxillofac Surg 2010;68:762-767.
8. Dachi SF, Howell FV. A survey of 3,874 routine full mouth radiographs. Oral Surg Oral Med Oral Pathol 1961;14:916-924.
9. Becker A, Smith P, Behar R. The incidence of anomalous maxillary lateral incisors in relation to palatally-displaced cuspids. Angle Orthod 1981;51:24-29.
10. Oliver RG, Mannion JE, Robinson JM. Morphology of the maxillary lateral incisor in cases of unilateral impaction of the maxillary canine. Br J Orthod 1989;16:9-16.
11. Peck S, Peck L, Kataja M. The palatally displaced canine as a dental anomaly of genetic origin. Angle Orthod 1994;64:249-256.
12. Fournier A, Turcotte J, Bernard C. Orthodontic considerations in the treatment of maxillary impacted canines. Am J Orthod 1982;81:236-239.
13. Jacoby H. The etiology of maxillary canine impaction. Am J Orthod 1983;84:125-132.

14. Stellzig A, Basdra EK, Koumrposch G. The etiology of canine tooth impaction: a space analysis. Fortschr Kieferorthop 1994;55:97-103.

15. Zhong YL, Zeng XL, Jia QL, et al.. Clinical investigation of impacted maxillary canine. Zhonghua Kou Qiang Yi Xue Za Zhi 2006;41:483-485.

16. Kim Y, Hyun HK, Jang KT. The position of maxillary canine impactions and the influenced factors to adjacent root resorption in the Korean population. Eur J Orthod 2012;34:302-306.

17. Zilberman Y, Cohen B, Becker A. Familial trends in palatal canines, anomalous lateral incisors and related phenomena. Eur J Orthod 1990;12:135-139.

18. Peck S, Peck L, Kataja M. Prevalence of tooth agenesis and peg-shaped maxillary lateral incisor associated with palatally displaced canine anomaly. Am J Orthod Dentofac Orthop 1996;110:441-443.

19. Becker A. Etiology of maxillary canine impactions. Am J Orthod 1984;86:437-438.

20. Brin I, Becker A, Shalhav M. Position of the maxillary permanent canine in relation to anomalous or missing lateral incisors: a population study. Eur J Orthod 1986;8:12-16.

21. Mossey PA, Campbell HM, Luffingham JK. The palatal canine and the adjacent lateral incisor: a study of a west of Scotland population. Br J Orthod 1994;21:169-174.

22. Baccetti T. A controlled study of associated dental anomalies. Angle Orthod 1998;68:267-274.

23. Chaushu S, Sharabi S, Becker A. Tooth size in dentitions with buccal canine ectopia. Eur J Orthd 2003;25:485-491.

24. Langberg BJ, Peck S. Tooth-size reduction associated with occurrence of palatal displacement of canines. Angle Orthod 2000;70:126-128.

25. Becker A, Sharabi S, Chaushu S. Maxillary tooth size variation in dentitions with palatal canine displacement. Eur J Orthod 2002;24:313-318.

26. Alqerban A, Jacobs R, Lambrechts P, et al.. Root resorption of the maxillary lateral incisor caused by impacted canine: a literature review. Clin Oral Investg 2009;13:247-255.

27. Bjerklin K, Kurol J, Valentin J. Ectopic eruption of maxillary first permanent molars and association with other tooth and development disturbances. Eur J Orthod 1992;14:369-375.

28. Bedoya MM, Park JH. A review of the diagnosis and management of impacted maxillary canines. J Am Den Assoc 2009;140:1485-1493.

29. Hoffmann E, Medelnik J, Keller T, et al.. Measuring mesiodistal width of impacted maxillary canines with CT. J Orofac Orthop 2011;72:33-44.

30. Hanke S, Hirschfelder U, Keller T, et al.. 3D CT based rating of unilateral impacted canines. J Cranio-Maxillofac Surg 2012;40:1-9.

31. Walker L, Enciso R, Mah J. Three-dimensional localization of maxillary canines with cone-beam computed tomography. Am J Orthod Dentofac Orthop 2005;128:418-423.

32. Oberoi S, Knueppel S, Francisso S. Three-dimensional assessment of impacted canines and root resorption using cone beam computed tomography. Oral Surg Oral Med Oral Pathol Oral Radiol 2012;113:260-262.

33. Yan B, Sun Z, Luo L, et al.. Etiologic factors for buccal and palatal maxillary canine impaction: A perspective based on cone-beam computed tomography analyses. Am J Orthod Dentofac Orthop 2013;143:527-534.

국문초록

상악 매복 견치와 인접치의 형태학적 상관관계 분석 (3 차원 재구성 CT 연구)

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(지도교수 장 기 택)

김 유 준

상악 견치의 매복과 상악 측절치의 형태 이상이 연관되어 있다는 것은 지금까지의 연구를 통해 잘 알려진 사실이다. 하지만 대부분의 연구는 구강 내 맹출한 치아를 본 떠 만든 진단 모형상에서 시행된 것으로, 아직까지 매복 상악 견치와 상악 측절치 치근 형태와의 상관 관계를 직접 분석한 연구는 많지 않았다. 이에 본 연구에서는 3차원 재구성 CT 영상을 이용하여 진단 모형에서는 직접 볼 수 없었던 절치 치근과 매복 견치 치

관의 형태 등을 조사하여, 상악 치아들(특히 상악 측절치)의 형태학적 특성과 매복 상악 견치 와의 연관성을 분석해 보았다.

치아의 형태학적 특징을 비교하기 위하여 한 환자에서 상악 견치가 매복된 측과 정상 맹출한 측을 동시에 갖고 있는 편측 매복 증례를 본 연구의 대상으로 선택하였다. 그리고 예비 연구를 통하여 표본 크기를 40 으로 결정하였다. 표본 선택에 있어 오류를 최소화 하기 위하여, 성별은 남녀 각 20 명씩 동 수로 하였고 매복 위치 또한 협측 매복과 구개측 매복 증례를 각 20 개씩 동 수로 하였다. 위 조건에 맞게 선택된 표본의 평균 나이는 13.5 ± 2.3 세 이다. 선택된 40 명 환자의 multislice spiral computed tomography (MSCT) 사진을 OnDemand 3D (Cybermed Co., Seoul, Korea) 프로그램을 통해 3 차원 사진으로 재구성 하였다. 이렇게 얻은 3 차원 재구성 사진 상에서 주변 해부학적 구조물들을 하나씩 제거하여 상악 치아들을 각각 분리해 낸 후, 그것의 형태학적 특징을 측정하였다.

그 결과 상악 중절치는 치관 및 치근 형태 모두 두 그룹 간에 유의한 차이를 보이지 않았다. 그러나 상악 견치가 정상 맹출한 측에 비교하여 상악 견치가 매복된 측의 상악 측절치 치근의 길이(P=0.001)와 부피(P=0.006)는 모두 통계적으로 유의하게 더 작은 것으로 나타났다. 또한 매복된 상악 견치 치관의 너비(P=0.020)와 부피(P<0.0001)는

정상 맹출 측과 비교하여 매복된 측에서 통계적으로 유의하게 더 큰 것으로 조사되었다.

기존 연구에서는 측절치 치관의 크기가 작기 때문에 치근의 크기도 작을 것이라 유추하여, 더 작은 크기의 측절치 치근이 상악 견치 매복에 있어서 병인 요소가 될 것이라는 가설을 세웠다. 하지만 본 연구에서는 두 군간 측절치 치관의 형태가 통계적으로 차이가 나지 않음에도 불구하고, 치근의 길이와 부피가 차이가 난다는 것을 직접적인 치관과 치근의 계측을 통해 찾아냈다. 이것이 본 연구가 가지는 중요 의의라 할 수 있다. 그리고 매복된 측의 견치 치관 크기가 더 크게 계측된 것 또한 맹출 공간 부족이 상악 견치 매복의 병인 요소가 된다는 기존 주장을 뒷받침해 주는 근거 자료가 될 수 있다.

주요어 : 매복 상악 견치, 측절치 치근 형태, Guidance theory, 3 차원 재구성 CT

학 번 : 2012-30592