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Research Article
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Position and Distribution of Maxillary Displaced Canine in a Japanese Population: a Retrospective Study of 287 CBCT Scans

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Abstract

Objective: To assess the position, location, and distribution of maxillary displaced canines in a sample of Japanese population and to develop a classification for the maxillary displaced canine depending on the position in order to facilitate proper diagnosis of this frequently encountered clinical problem.

Methods: Cone beam computed tomographic scans of 287 Japanese orthodontic patients (mean age 11.2 ± 1.8 years) with maxillary displaced canines were collected from private dental clinics in Himeji city, Japan. The maxillary displaced canines were evaluated and classified into ten different groups (Types A-J) according to their position and location.

Results: Type B in which the canine is in a vertical position behind the lateral incisor causing root resorption in the apical one third of the lateral incisor was the most common (47%) followed by Types A and C in which the canine is either impacted in a mesioangular position behind the central incisor root causing root resorption in the apical one third of the central incisor or impacted in a vertical position between the lateral incisor and the first premolar without causing root resorption (17.1% and 16%) respectively. Types I and J were the rarest (0.4%).

Conclusion: Maxillary displaced canines were classified into ten different groups according to their positions and locations because of the high variations. The development and standardization of a defined classification is essential for proper diagnostic and therapeutic considerations.

Keywords: Maxillary displaced canine; Cone beam computed tomography

Introduction

Permanent canines are considered strategic because of their roles in establishing the dental arch form, involvement in the esthetic smile, and contribution to the functional occlusion. They are the second most frequently impacted or displaced teeth after the third molars. Treatment of the impacted canine is a lengthy and complex procedure and most of the times require interdisciplinary approach. The prognosis can only be judged when the exact position and location of the tooth is accurately determined. Moreover, proper localization of the impacted canine plays an essential role in determining the probability of the surgical approaches and the best access to use, as well as the proper direction of orthodontic forces application [1-4].

There is a wide variation among different racial populations in the prevalence of the impacted canine. In Caucasian populations, impacted maxillary canines prevalence range from approximately 1% to 3% with 70-80% palatal impactions. In Sweden, it was estimated to be 1900 cases/year; with palatal displacement being more common than labial displacement and the ratio varies from 2:1 to 9:1 for canine displacements. In Asian subjects, the impacted canines were usually midalveolus or labial, and the prevalence ratio of European: Asian for a palatal position has been reported to be 5:1 [4-7].

Various radiographic techniques including the panoramic radiographs have been advocated for the determination of the position of the maxillary displaced canine (MDC). Cone beam computed tomography (CBCT) however, is considered superior to the traditional two-dimensional images with regards to maximizing the information and details obtained on the dental and bony structures. The objectives of the present study was to assess the position, location, and distribution of MDCs in a sample of Japanese orthodontic patients and to develop classification of the MDC depending on the position in order to facilitate proper diagnosis of this frequently encountered clinical problem.

Materials and Methods

In this retrospective, observational study, the database of 3D CBCT images of several private clinics in Himeji city, Japan was searched and cases with MDC were identified. The study sample comprised 287 Japanese patients (mean age 11.2 ± 1.8 years) with MDCs. Pre-orthodontic treatment CBCT Images for all the included subjects were obtained using the Alphard-3030 (Asahi Roentgen Ind Co Ltd, Kyoto, Japan) CBCT machine. The CBCT scans were performed at 80 Kv and 2 mA with a scan time of 17 seconds and voxel dimensions of 0.39 × 0.39 × 0.39 mm. The data for each subject were evaluated with stereotaxic 3D-CT software produced by Imagnosis (Orlando, FL, USA). Both right and left inferior borders of the infraorbital foramina and the midpoint between right and left superior borders of the external auditory canals

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were used as reference points. The plane constructed by these three reference points was used as a reference plane. The coronal plane was through the cusp tip of the most anterior maxillary first molar, perpendicular to the Frankfort Horizontal (FH) and midsagittal planes. Subjects were selected according to the following inclusion criteria: no history of previous extraction or orthodontic treatment, no cleft lip, palate, or craniofacial anomalies, no history of trauma to the jaw bones, no missing lateral incisors, and a good quality of the CBCT scan.

The 287 MDCs were identified and classified into ten different groups (Types A-J) according to their position and location. These groups were based on a hypothesized classification which contains all possible positions and locations of MDC (Figure 1).

Classification of maxillary canine displacement is defined in Table 1 and Figures 2-11.

Results

Almost half of the MDCs were classified as Type B (47%) where the canine is in vertical position behind the lateral incisor causing resorption of the apical one third if its root. Type A where the canine is in a mesioangular position behind the central incisor root causing resorption in the apical one third of the central incisor accounted for 17.1% of the cases. Types C and D where the canine is in vertical position either between the lateral incisor and 1st premolar or between the 1st and 2nd premolars comprised 16% and 3.5% respectively. Types F and H where the canine is in horizontal position either near to the inferior wall of maxillary sinus with the crown positioned distally or between the lateral incisor and 1st premolar comprised 1.4% and 5.8% respectively. Type E in which the canines were in mesioangular direction lying between the anterior-inferior wall of the maxillary sinus and the basilar part of the nasal cavity represented 6.3% of the cases. Type G where the canines were impacted vertically with their roots inside the maxillary sinus represented 2.1% of the cases. The palatal position of the MDCs (Type J) as well as the canine impacted completely inside the maxillary sinus (Type I) were only reported in one case representing 0.4% of the sample (Table 2).

Discussion

The maxillary displaced permanent canine is a frequently encountered clinical problem. The eruption of the permanent maxillary canine represents a complicated series of events that are basically genetically determined and affected by local factors. It is also considered the longest eruption path of all teeth. [8,9] Previous investigations have summarized the different factors responsible on the eruption disturbances of the maxillary permanent canine into two major theories, the 'guidance theory' and the 'genetic theory'. The guidance theory indicates that the lateral incisor root guides the eruption of the canine crown in the proper direction. When this function fails, the canine becomes displaced. According to the genetic theory, the displacement of the canine is genetically determined. [9] The size and dimension of the jaws, malocclusion, eruption problems, as well as the ethnicity of the patients are also factors that need to be considered.

MDCs require complex and time-consuming interdisciplinary therapeutic management, which can be considered successful only if the forced eruption and the subsequent alignment lead the tooth to the correct position in the dental arch without serious damage to other structures. Therefore, proper treatment planning requires correct and accurate localization and classification of the tooth. The aim of the present study was to evaluate the position and distribution of MDCs

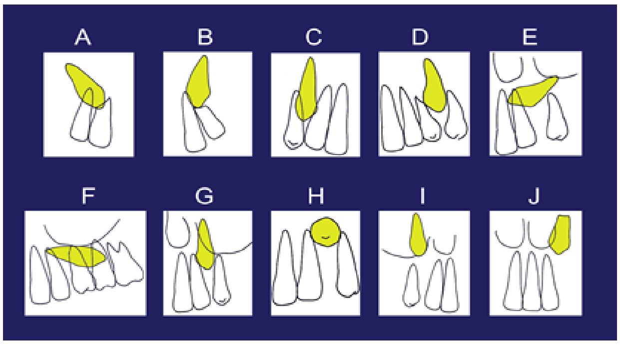

Figure 1: Classification of the maxillary displaced canines

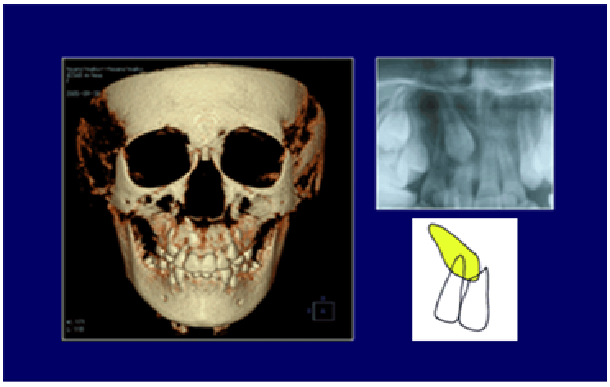

Figure 2: Type A

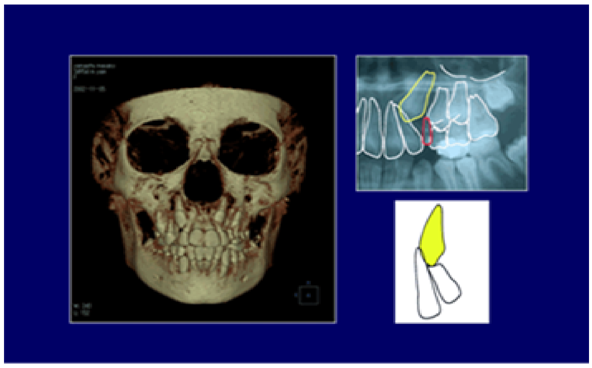

Figure 3: Type B

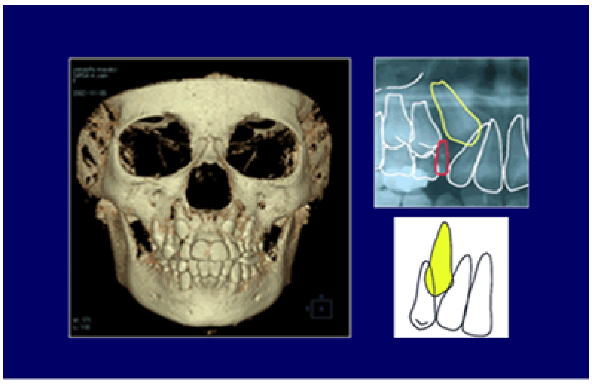

Figure 4: Type C

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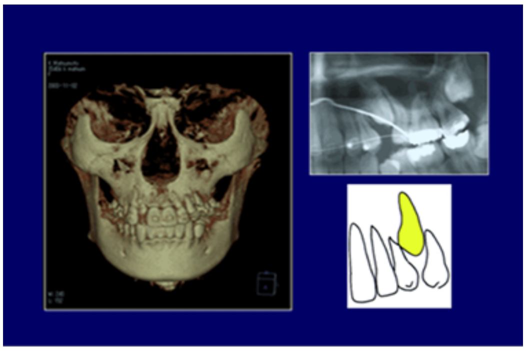

Figure 5: Type D

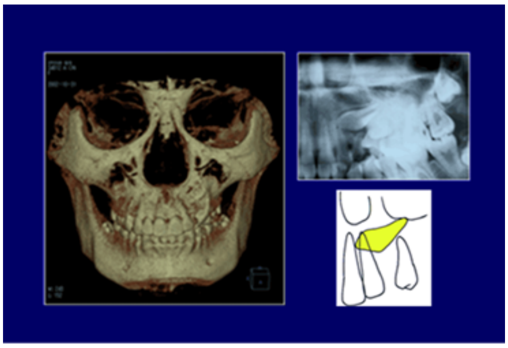

Figure 6: Type E

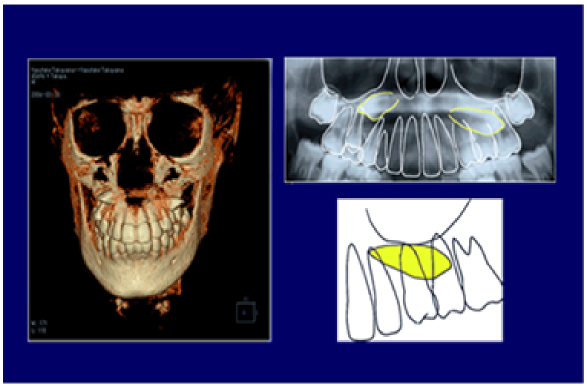

Figure 7: Type F

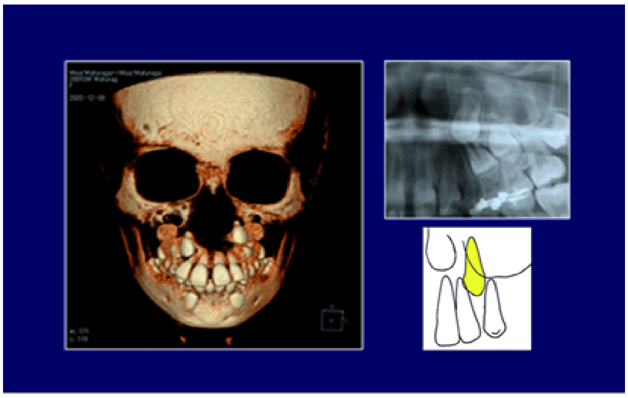

Figure 8: Type G

in a sample of Japanese population and to develop classification that include all possible positions and relations to the adjacent structures to facilitate the choice of the treatment and improve the diagnosis.

Although two-dimensional radiographs such as periapical, occlusal, panoramic, and cephalometric radiographs are considered the standard diagnostic tool in orthodontics for the pre-operative diagnosis of the majority of cases, their accuracy and validity for localizing impacted canines and adjacent structures is limited due to drawbacks that may cause misinterpretation such as superimposition, magnification, and distortion projection errors. In addition, the visualization of the longitudinal axis and the proximity to the adjacent bony and dental structures are often inaccurate because these complex structures overlap in the maxillofacial region [10-11]. In the present study, CBCT scans were used to ensure accurate localization of the canine and proper evaluation of resorption of incisors and relationships with the neighboring bony and dental structures, due to the superior hard tissue contrast and the detailed three-dimensional images.

Previous reports on the midfacial region growth and development indicated that the growth of the upper jaw in sagittal direction is most likely stable from the age of 8-18 years with an average increase of 0.2 mm/year while the vertical growth as well as the general maxillary growth was found to be greater from 8-11 years [12]. For this reason, only patients aged from 11 to 16 years at the time of initial records were selected in this study.

The results of the present study showed that Type B in which the canine is in a vertical position behind the lateral incisor causing root resorption in the apical one third of the lateral incisor was the most common (47%) followed by Types A and C in which the canine is either impacted in a mesioangular position behind the central incisor root causing root resorption in the apical 1/3 of the central incisor or impacted in a vertical position between the lateral incisor and the first premolar without causing root resorption (17.1% and 16%) respectively. Types I and J were the rarest (0.4%). These results were different from those of Liu et al. [13] who reported that in Chinese population, the buccolingual positions of impacted canines were 45.2% labial, 40.5% palatal, and 14.3% midalveolus [13]. These differences in results could be explained by the fact that each population is different in the genetic and ethnic background.

In an attempt to investigate the relation between MDC and the dental and skeletal morphology, Jacoby [14] reported that 85 percent of impacted canines were located palatally and concluded that they occur in patients with adequate arch length. Patients with arch length deficiency are at risk of canine impaction because canine cannot achieve the normal eruption path to come in occlusion. A number of factors might lead the canine to be impacted palatally if extra space is available in the maxillary bone. This space can be due to excessive growth in the base of the maxillary bone, space created by agenesis or peg shaped lateral incisors (undersized lateral incisor), or stimulated eruption of the lateral incisor or the first premolar. In those conditions the canine is free to "dive" in the bone and to become palatally impacted. A dysplasia in the maxillary-premaxillary suture can also modify the direction of the maxillary canine's eruption.

Kim Y et al. [15] studied interrelation between the position of impacted maxillary canines and the morphology of the maxilla. The results indicated that the shape of the maxillary arch was narrower and longer in the palatally impacted canine group compared with the buccally impacted canine group. The palatally impacted canine group showed deeper palatal vault than the buccally impacted canine group.

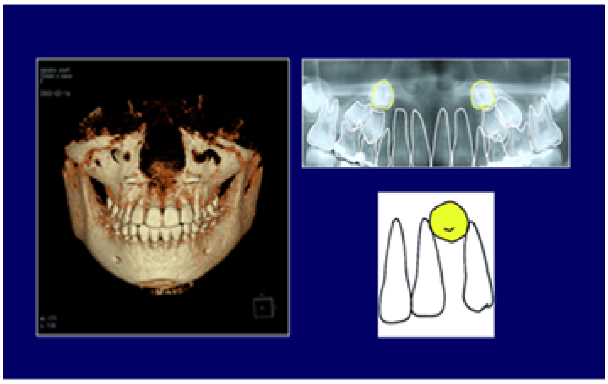

Figure 9: Type H

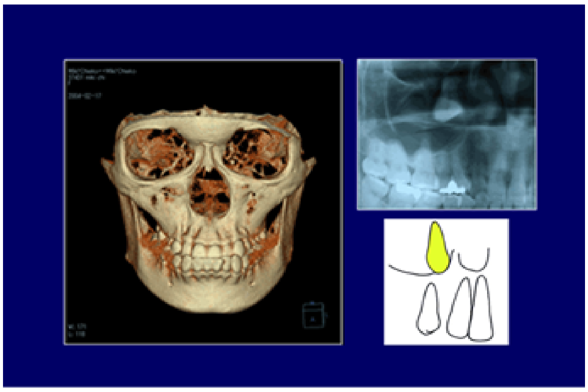

Figure 10: Type I.

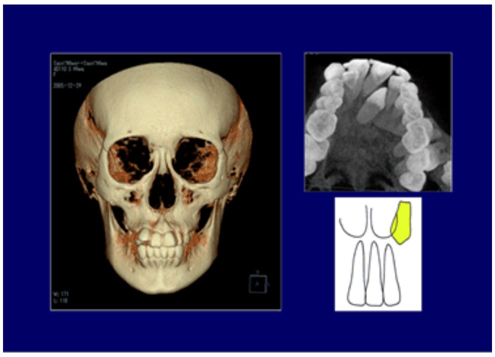

Figure 11: Type J.

Fattahi et al. [16] found that there is no statistically significant difference in arch width, palatal vault and palatal height index in palatally impacted group and the control group of Iranian population. However, there is a lack of information of palatal depth in ethnic difference. Kuftinec and Shapira [17] agreed that premaxillary skeletal deficiency is often associated with labial impaction of maxillary canines. They also stated that maxillary excess can be associated with palatal impaction of maxillary canines. The premaxillary skeletal deficiency was associated with anterior crowding and anterior cross bite.

Therefore, a possible explanation for the differences in the positions and frequency of the MDCs between different populations could be the differences in the dimensions and the morphology of the maxillary dental arch.

The results of the present study indicated that root resorption caused by pressure from MDC in Japanese population is common. The occurrence of root resorption in Korean population was as high as 49.5%. A study in Chinese populations shows 27.2% of lateral and 23.4% of central incisors, and 94.3% of these resorptions occurred where the impacted canines were in close contact with the incisors [13].

In the present study, we have classified the MDCs into different groups according to their positions and locations. Because of the high variations, it was found that these positions can be classified into 10 different groups which included all possibilities. We believe that this classification could provide the base for future extensive research that will allow the development of specific measurements and parameters for each position or type of MDC which is very helpful to the clinicians enabling the correct decisions about surgical approaches and treatment planning.

In conclusion, maxillary displaced canines were classified into ten different groups according to their positions and locations because of the high variations. The development and standardization of a defined classification is essential for proper diagnostic and therapeutic considerations.

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