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Treatment of Maxillary Horizontal Impacted Canine – A New Method

Abstract: The horizontally impacted unerupted canine is considered orthodontically difficult to treat. A treatment method using a modified Nance Palatal Arch with a vertical bar extending into the buccal vestibule area is used to alter the eruption path of the impacted canine crown, hence avoiding interference with the lateral incisor root. The anchorage is re-inforced by the palatal component of the Nance Arch. The results are highly predictable and undesirable side-effects can be minimized. The structure of the special appliance, the treatment mechanism and the sequence of the treatment are described in this article.

Clinical Relevance: Ectopic canines pose a difficult clinical problem, particularly in relation to anchorage issues. A method is suggested that circumvents many of these issues.

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Ectopic eruption of the maxillary canine is a frequently encountered problem.[1-3] The prevalence of impacted maxillary canines is 2–3%.[1,2] The impacted canine crown is palatal in 61% of cases, in the line of the arch in 34% of cases and buccal or labial in 5% of cases.[4] Aesthetically and functionally it is usually preferable, whenever possible, to move the impacted canine to its normal position in the arch.[3,5-12]

The prognosis for orthodontically aligning an impacted maxillary canine depends on the position and angulation of the tooth and the age of the patient.[4,7,13,14] Stivaros and Mandall[4] studied the factors that affect the management of impacted maxillary canines by a retrospective, cross-sectional study. They found that the decision to expose or remove an impacted maxillary canine, on the basis of radiographic information, seems to be primarily guided by its labiopalatal crown position and angulation to the midline. As the angulation of the canine axis to the midline increases, and the crown of the canine is situated labially or in the line of the arch, the canine is more likely to be surgically removed by the orthodontist. Further, Pitt *et al*[13] devised a treatment difficulty index for unerupted maxillary canines. The horizontal position, the age of the patient, the vertical height and bucco-palatal position of the canine, in descending order of importance, are the factors which determine the difficulty of canine alignment.

Factors complicating the alignment of the horizontal impacted canine with the crown buccally, or in the line of the arch, and lying over the roots of the lateral incisors are:

- The possibility of interference and resorption of the lateral incisor root;
- The long treatment period; and
- The need for complicated mechanics.[4,7,13]

In order to overcome these challenges, a Modified Nance Arch (MNA) was designed to apply and monitor the three-dimensional force direction needed for precisely controlled tooth movement. The results are highly predictable and undesirable side-effects can be minimized. This article describes the appliance, and highlights the advantages it brings to the treatment of ectopic canines.

Materials and methods

All 8 maxillary horizontally impacted canine patients (6 female, 2 male) were referred to the Orthodontic Department of the Stomatology Hospital, Wenzhou Medical College during 2003–2008, ranging in age from 13.20 to 18.20 years (mean 15.72 ± 1.70).

Three-dimensional computed tomography scans were taken of each patient's maxilla, along with conventional records, including a panoramic radiograph, a lateral cephalograph, intra-oral photographs and plaster casts. The angulation of the canine axis to the midline was from 68°–82° (mean 75.86 ± 4.45). The active treatment times were 18 to 28 months (mean 21.62 ± 3.36). All the cases were treated successfully by a combination of a Modified Nance Arch and fixed appliances.

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Figure 1. Pre-treatment intra-oral photograph: 15-year-old female with a maxillary horizontal impacted canine on the right side, with crown in the line of the arch.

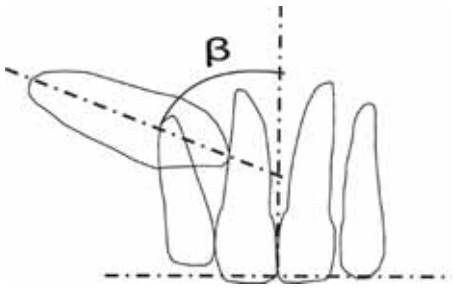

Figure 2. Canine angulation to the midline (β).

Figure 3. Pre-treatment panoramic radiograph.

Figure 4. Three-dimensional Computer Tomography.

Figure 5. The vertical bar of the MNA.

Figure 6. The palatal part of the MNA.

Structure of the modified Nance appliance

This device is a modification of a Nance holding Arch with the addition of an adjustable vertical bar in the upper vestibular area. The vertical bar consists of 0.9 mm diameter stainless steel wire embedded in the centre of the palatal acrylic component of the Nance Arch. It then passes through the space between the lateral incisor and first bicuspid tooth and extends into the buccal vestibule as a vertical bar, with a small hook at the end. The position of the hook in the vestibular area can be adjusted in three-dimensions by changing the length and location of the vertical bar.

Case study

A 15-year-old female presented with a significant space in the upper right arch with the canine unerupted and the adjacent lateral incisor crown inclined forward (Figure 1). Radiographs showed that the maxillary right canine was in a horizontal position with its crown tip crossing the lateral incisor root apex and reaching the distal surface of the right upper central incisor root. The β angle was 75° (Figure 2). On the panoramic radiograph (Figure 3), it was not clear whether the root apex of the lateral incisor had been resorbed. Three-dimensional Computer Tomography, however, showed that the crown of the right canine was in the line of the arch and the lateral incisor root apex was slightly shortened with root apex closure (Figure 4).

The impacted canine was surgically exposed, a lingual button with a double-strand metal ligature was bonded on the exposed surface of the canine crown, and a Modified Nance Arch (MNA) was cemented on the upper arch (Figures 5 and 6). One week later, the sutures were removed. About 60 g of traction force was applied to the canine by an elastic chain from the hook of the MNA (Figure 7a).

The force was directed first buccally, then vectored disto-buccally by gradually altering the position of the hook; the vector between the hook and the crown of the impacted tooth should always angle away from the root of the lateral incisor. After the crown moved away from the root of the lateral incisor, the force was directed distally and downward. The impacted canine crown was moved away from the lateral incisor in stages (Figures 7 b, c).

The upper arch was bonded with a 0.22" x 0.28" pre-adjusted appliance and was aligned by a series of archwires; space for the canine was created in the upper arch. When the crown of the impacted canine was close to the arch, it was re-bonded with a correctly positioned bracket and aligned into the arch line.

The active treatment was 19 months. A good inter-occlusion was achieved. The maxillary right lateral incisor root is still slightly short but exhibits no obvious resorption (Figures 8, 9). The upper bands and brackets were removed and replaced with a maxillary Hawley retainer.

Discussion

Normally, radiographic imaging is the commonest tool for diagnosis,[15,16] but when multiple and complex impacted canines are present, CT scanning, especially spiral CT,[17] is very useful for the localization of impacted maxillary canines, especially where there is a possible contact, with

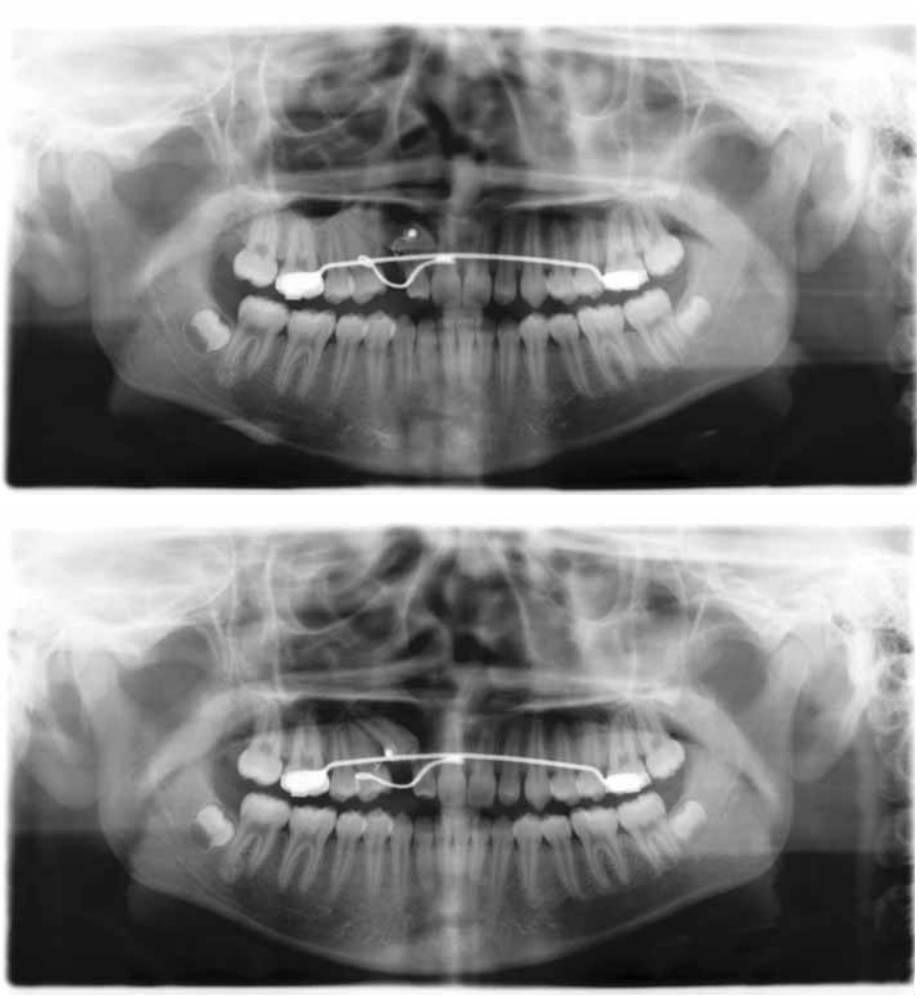

Figure 7. (a–c) Progress records: The force direction was gradually altered from buccally, to disto-buccally, to downward. The impacted canine's crown was moved away from the lateral incisor in stages.

actual or potential incisor root resorption. In this reported case we were initially unsure whether the lateral incisor root was compromised as it was overlapped by the impacted canine crown on panoramic radiograph views. However, its root apex was not resorbed nor in contact with the canine crown when investigated using spiral CT.

The positioning of horizontal impacted canines with the crowns buccally or in the line of the arch in the permanent dentition stage is a complex procedure.[4,6,7,14] All factors should be considered in designing the treatment plan to include the following:

- A long range of action;
- Good control in the three dimensions, sagittally, vertically and coronally;
- Good anchorage control; and
- Absence of patient involvement in placing the force on the tooth.

It is reported that where the canine lies more horizontally, it is more likely to be untreatable.[4,7,14] The horizontal impacted canine's crown is usually located mesially, above the adjacent lateral incisor root, and the eruption path will be obstructed by this root, owing to the fact that the shape of the maxillary base arch is a parabolic curve with the canines and lateral incisors in the anterior corner. In attempting to move the canine crown, the lateral incisor root may be damaged by the application of traction force directly to the archwire; alternatively, the canine may not move. D'Amico *et al*[18] investigated the medium term results of the treatment of impacted maxillary canines. In a study of 83 canines with a mean follow up time of 3.5 years, they found 11 lateral incisors had been extracted because of severe root resorption. Of the 83 canines, 45 were associated with the resorption of nine central incisors and 40 lateral incisors. Becker and Chaushu[19] concluded that, when resorption of an incisor root occurs as the result of an impacted canine, the patient should be treated urgently, the treatment being designed to move the canine away from the resorbing tooth as quickly as possible.

Some articles focus on how to move the canine crown away from the resorbing tooth root in palatally impacted canines.[5,7,11] In buccally impacted canine cases, only one article[10] described a removable appliance for the three-dimensional movement of ectopic maxillary canines. However, this method required patient co-operation in placing the force on the tooth and could not be combined with a fixed appliance to create space for the impacted tooth or, indeed, to treat any other malocclusion. The MNA is designed to alter the eruption path of impacted canine crowns, the crown of the canine being moved first buccally, then disto-buccally and, after the crown of the canine is distanced from the lateral incisor root, it is moved distally and downward. The alteration of force vector is easily achieved by changing the position of the hook in the vestibular area. If the crown of the canine is impacted at a high level in the maxillary base where the cortical bone is thick, the burden of anchorage is heavy.[5-7,10–12] The impacted canine needs to be moved occlusally a

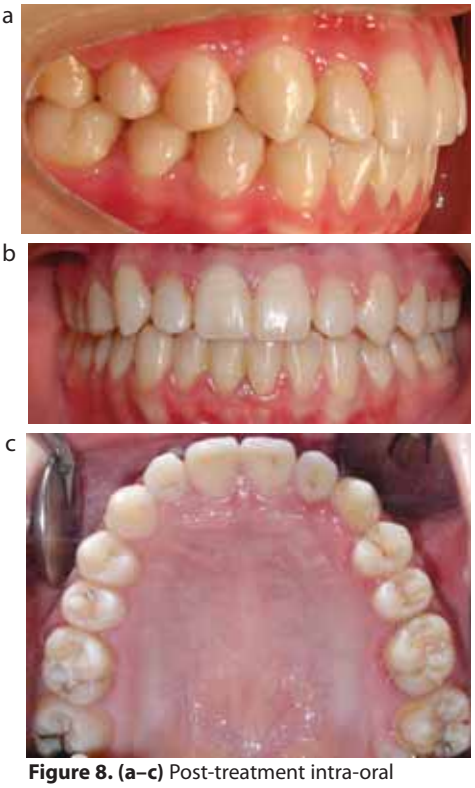

Figure 8. (a–c) Post-treatment intra-oral photographs.

Figure 9. Post-treatment panoramic radiograph.

considerable distance to attain its correct position. Noble and Orton [7,10] used a removable appliance as anchorage, but this still relied on the patient's compliance. Other authors[5,6,11] reported that they have treated impacted canines with a Double Arch Technique, the main archwire being used as the anchorage. Nevertheless, the burden of anchorage was still on the dentition, the forward tipping of the first premolar and backward tipping of the lateral incisor being observed together with their intrusion, creating a lateral open bite in the canine region. Park *et al*[12] suggested that a micro-implant anchorage be placed to allow forced eruption of the impacted canine, however, this means added expense and an additional surgical procedure. The MNA can transfer anchorage demands to the acrylic palatal plate, the palatal mucosa and the alveolar ridge. This will decrease any undesired movement of the adjacent teeth. Further, we can move the impacted canine immediately after the MNA is placed without the need for prior tooth alignment and large archwire placement. It is especially beneficial in the treatment of horizontally impacted canines with the crowns buccal or in the line of the arch, since this tooth has the farthest distance to travel.

We can also treat the impacted canine using the MNA in isolation in the early stages of treatment. It is well accepted by the adult patient, and also useful in cases where the canine has an uncertain prognosis, as in those that have been ankylosed,[20,21] and in some moderately crowded cases where it is difficult to decide initially whether the impacted canine or the first premolar should be extracted. In these cases, the impacted canine can be moved by the MNA alone and observed carefully. If it becomes obvious that the traction is successful, the first premolar can be extracted, otherwise, the impacted canine can be removed surgically.

In conclusion, the Modified Nance Arch (MNA) with an adjustable vertical bar in the upper vestibular area is a useful technique for the treatment of ectopic unerupted canines, and is sufficiently flexible to adapt to most clinical situations.

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