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# Prediction of Impacted Maxillary Canine Eruption using Warford Method

SUMMARY

*Impaction most commonly involves lower third molars, followed by permanent upper canines. Warford et al[11] used a bi-condylar line as a horizontal reference line to predict the maxillary canine impaction in mixed dentition. The measurement was taken of the mesial angle formed by using the constructed horizontal and the long axis of the maxillary canine.*

*In this study, a modified Warford method was used for young adults and results after orthodontic treatments were discussed. 4 patients with impacted canines were examined using the Warford method. When evaluating the impacted canine cases, the modified Warford method must be applied carefully and local conditions, like root anatomy, should also be evaluated.*

**Keywords:** Impacted Canine; Orthodontics; Warford Method

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## Introduction

Impaction most commonly involves lower third molars, followed by permanent upper canines. Dachi and Howel[2] reported that the incidence of maxillary canine impaction is 0.92%, whereas Thilander and Myrberg[10] estimated the prevalence of canine impaction in 7- to 13-year-old children to be 2.2%. Ericson and Kurol[4] estimated the incidence at 1.7%. Impactions are twice as common in females (1.17%) than in males (0.51%). 85% of impacted canines are located palatally. Fournier et al[7] reported a palatal-to-buccal impaction ratio of 3:1, and Jacoby[8] reported a ratio of 12:1. Of all patients with maxillary impacted canines, it is estimated that 8% have bilateral impactions. The incidence of mandibular canine impaction is 0.35%[2].

Besides generalized causes, including endocrine deficiencies, febrile diseases, and irradiation, there are localized factors that cause for canine impactions, like prolonged retention or early loss of the deciduous canine, abnormal position of the tooth bud, tooth size-arch length discrepancies, the presence of an alveolar cleft, ankylosis, cystic or neoplastic formation and dilaceration of the root[1].

The aim of this study was to use Warford's method[11] in young adults, and evaluate the treatment results of impacted canines according to their angulations.

## Method

To predict the maxillary canine impaction, Warford et al[11] drawn a bi-condylar line and used as a horizontal reference. The measurement was taken of the mesial angle formed by using the constructed horizontal and the long axis of the unerupted tooth (Fig. 1). Mean angulation was found to be $75.1^0$ for non-impacted teeth, and $63.2^0$ for impacted canines[11].

According to Warford's method, horizontally positioned canine tooth supposed to be impacted, and canines that positioned at an angle of $75^0$ or higher showed no difficulties on eruption .

### *Case 1*

E.S. was a 14-year-old female patient. She had symmetric face and straight profile. Intraoral examination showed a spaced upper arch with unerupted maxillary canines and a mildly crowded lower arch (Fig. 2). In occlusion, she had a 1 mm overjet, and a 4 mm overbite. Radiographic examination showed all teeth, including the third molars. Both maxillary canines having well developed roots, were impacted. According to Warford's method, right canine's angulation was $61^0$ and left canine's angulation was $44^0$. During the fixed orthodontic treatment, the right canine tooth erupted spontaneously while the left canine tooth was forced to erupt (Fig. 3).

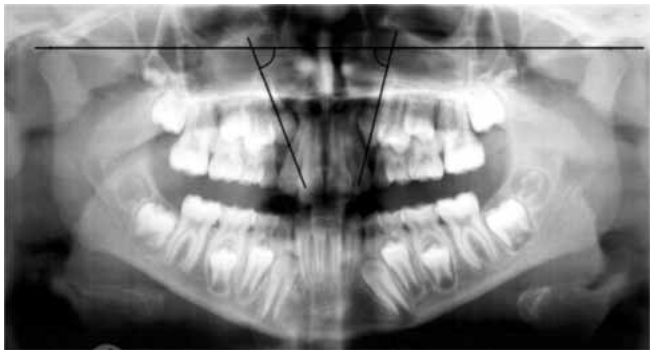

*Figure 1. Angular measurement of unerupted canines accoding to Warford method. 7*

*Figure 2. Case 1. Before treatment.*

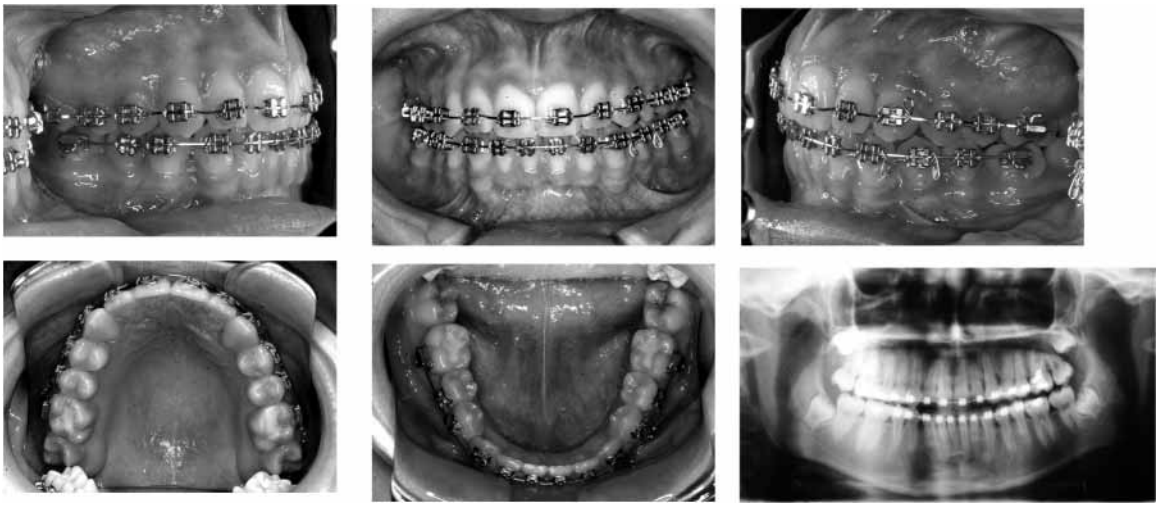

*Figure 3. Case 1. After canine brought into occlusion.*

## *Case 2*

M.C. was a 18-year-old female patient. She had symmetric face and straight profile. Intraoral examination showed a spaced upper arch with unerupted right maxillary canine and a mildly crowded lower arch (Fig. 4). In occlusion, she had a 3 mm overjet and a 4 mm overbite. Radiographic examination showed all teeth, including the third molars. According to Warford's method right canine's angulation was $62^0$. With orthodontic treatment the impacted right canine tooth was forced to erupt and brought into occlusion (Fig. 5).

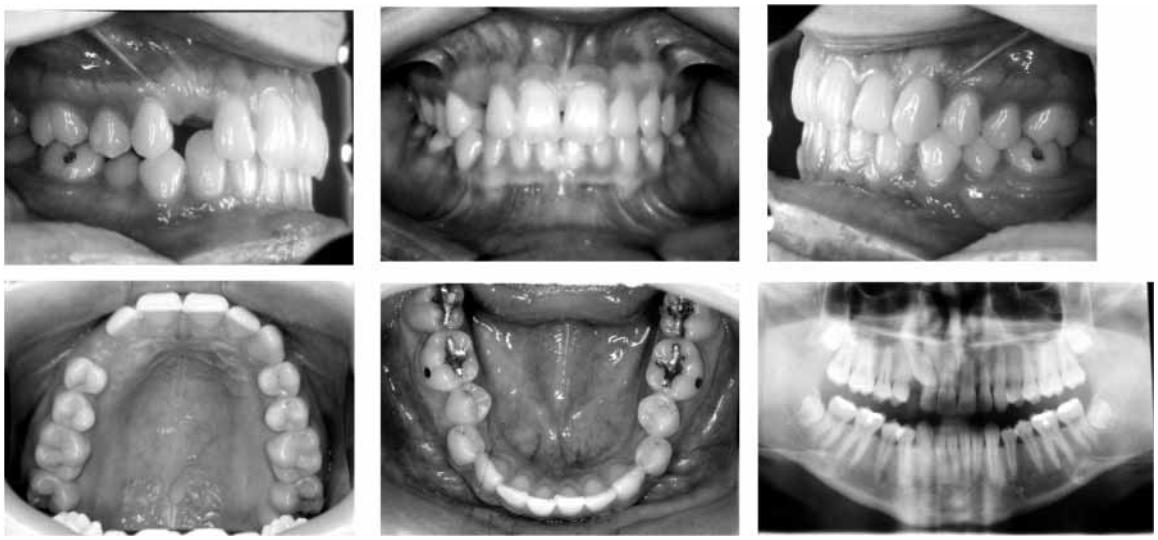

*Figure 4. Case 2. Before treatment.*

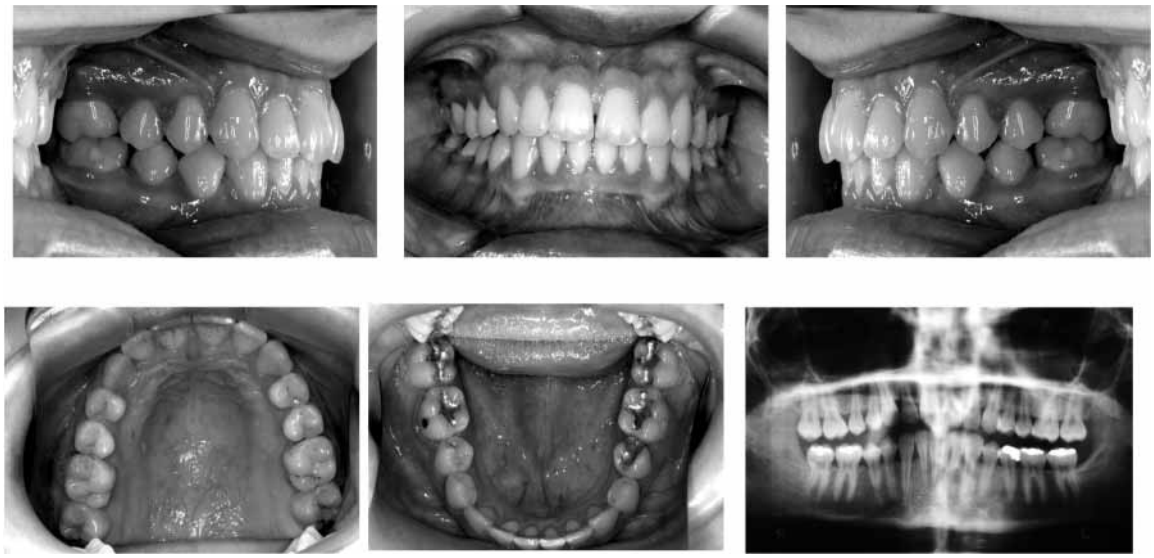

*Figure 5. Case 2. After orthodontic treatment.*

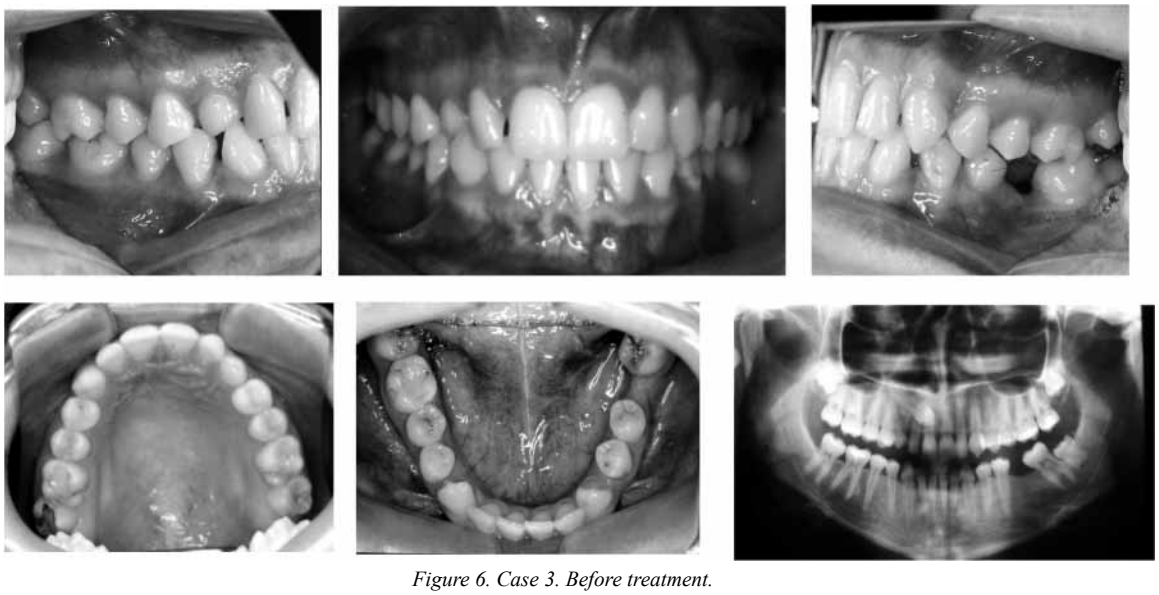

*Figure 6. Case 3. Before treatment.*

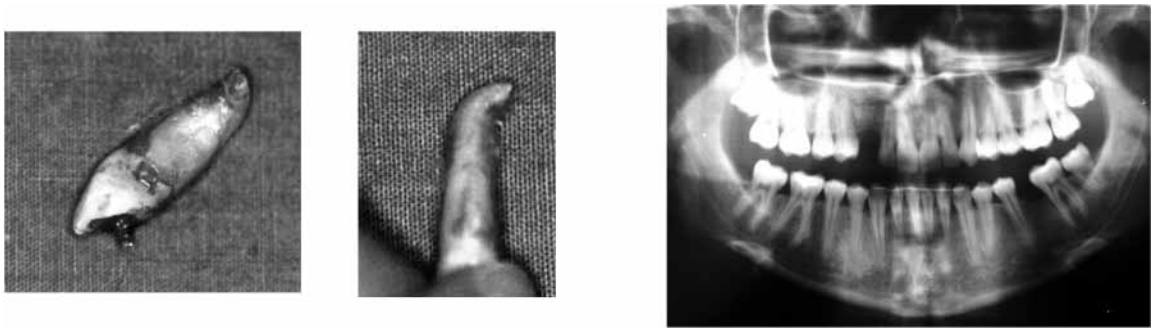

*Figure 7. Case 3. Impacted canine after extraction, panoramic radiography after extraction.*

### *Case 3*

C.A. was a 23-year-old female patient. She had symmetric face and straight profile. Intraoral examination showed a persisted right deciduous canine in the upper arch and a spaced lower arch with extracted left first molar tooth (Fig. 6). In occlusion, she had a 3 mm overjet and a 2 mm overbite. Radiographic examination showed all teeth, except extracted mandibular left first molar and mandibular right third molar. According to Warford's method, right canine's angulation was $37^0$. With orthodontic treatment, the impacted right canine tooth was tried to force-erupt but could not brought into occlusion. After extraction of the impacted tooth, the cause of the failure was seen – due to the tooth's apical root anatomy, the tooth could not respond the orthodontic forces (Fig. 7).

*Figure 8. Case 4. Before treatment.*

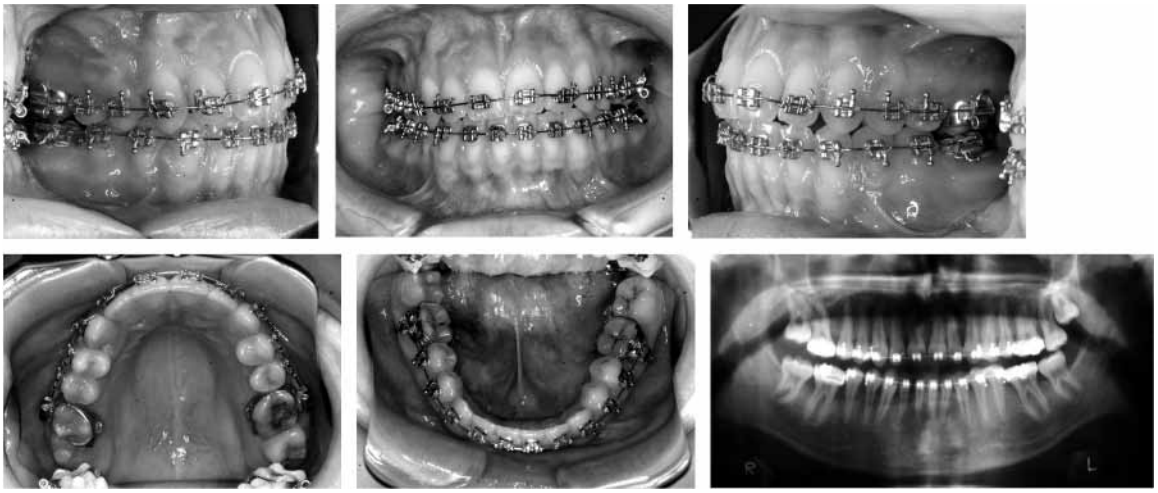

*Figure 9. Case 4. After canine brought into occlusion.*

***Case 4***

R.K. was a 15-year-old female patient. She had symmetric face and straight profile. Intraoral examination showed a spaced upper arch with extracted right first molar tooth and unerupted right canine, and spaced lower arch with extracted left first molar tooth (Fig. 8). In occlusion, she had a 2.5 mm overjet and a 2 mm overbite. Radiographic examination showed all teeth, except the extracted mandibular left first molar and mandibular right third molar. According to Warford's method, right canine's angulation was $80^0$. With orthodontic treatment, the impacted right canine tooth was forced to erupted and brought into occlusion, and all the extraction spaces were closed (Fig. 9).

## Discussion

Warford et al[11] used an angular measurement and a sector location for indication of maxillary canine impaction. To make angular measurement one needs reference line. Other investigators[5,6,9], who used panoramic radiography for angular measurement, preferred different reference lines. Power and Short[9] made angular measurements *via* a midline constructed from the perpendicular to the central incisors, and Ericson and Kurol[5] used a midline constructed from the mandibular central incisor proximal contact to the maxillary incisor interproximal contact.

These measurements depends on anterior dental relationships. For a proper investigation, one needs more reliable landmarks like skeletal landmarks[11]. Using the nasal floor would be a logical choice for a horizontal line, but Damante et al[3] described nearly 7 variable shapes of the hard palate and nasal fossa floor. Fernandez et al[6] measured the external angle formed by the major axis of the canine and the straight line through both suborbitary points. Using these landmarks from the panoramic radiography is not appropriate because it is hard to determine same points each time.

In Warford's study, bi-condylar line was used as a reference line, because the most superior point of the condyle was believed to be a proper landmark and logical choice for angular measurement. In this study Warford's method is used, because of its repeatability, validity and reliability.

Although the modified Warford method is easy to use, in the first case, right canine tooth that supposed not to erupt, erupted spontaneously during the fixed orthodontic treatment, without the forced eruption. Left canine was forced to erupt. The angulations of canines in the first and second cases that were force-erupted met the criteria of Warford method. In the third case, right canine's angulation was $37^0$ according to Warford's method, and this canine did not respond to treatment although it was surgically exposed twice. After 2 years of fixed orthodontic treatment, the tooth was extracted and it was seen that the tooth did not erupt due to the apical root anatomy. And in the fourth case, the canine tooth that supposed to erupt was forced to erupt during fixed orthodontic treatment.

## Conclusion

Warford's method is used to predict the canine forced eruption in 4 cases. The left canine in the first case, that was thought to rest impacted ($44^0$), also erupted. Consequently, to predict maxillary canine impaction, Warford method is easy to use, but it should be used carefully. Local conditions, especially root anatomy, should also be considered.

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