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Maxillary Canine Impaction Managed using Non-Invasive Technique: The Fixed Anterior Push Sagittal Appliance

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Abstract

Canine impactions/ ectopic canines are always challenging yet demanding to de-impact and most would require an interdisciplinary approach of combined surgical -orthodontic therapy or extraction if early intervention timing is missed.

Aim

This article presents cases with poor-average prognosis of maxillary canine erupting successfully using non-invasive technique for the practitioner and compliance free appliance for the patient: the fixed anterior push sagittal appliance.

Introduction

Canine impaction is best diagnosed early to prevent its ectopic eruption. Patients and their helping clinicians would want to defer surgical intervention, damage adjacent teeth and prevent loss of that tooth. Canine impactions are always challenging yet demanding to deimpact and most would require an

interdisciplinary approach of combined surgical orthodontic therapy or extraction if early intervention timing is missed. Mandibular 3rd molars are the most frequently impacted followed by canine impaction in the maxilla with approximately 2/3 being palatal (Stivaros and Mandall, 2000) and 8% being bilateral. (Bedoya and Park, 2009).

Development of canine is critical in understanding normal eruption pattern. At age 4-5months canine calcification commences and is completed by age 5-6 years. It develops high in the maxilla, piriform fossae being lateral to it and approximately 22mm path of eruption – being the longest for any tooth. It then migrates downwards and forwards to be palpable around age 10 in the buccal sulcus. (Ferguson, 1990) Female to male ratio is 7:3 (Mosey et al, 1994) with earlier eruption in females around ages 11-12 years. (Wedl et al., 2004) Canine is considered impacted if unerupted after ¾ root formation (Litsas and Acar, 2011), 6months or more of the contralateral tooth eruption and complete root formation. Or finally, canine position is still intra osseous at or beyond cervical stage 5 or 2 years post adolescent growth spurt or 6 months after its root development completion (Lindauer et al, 1992).

Aetiology of impacted canines is multifactorial related to environmental and genetic factors. Path of eruption is long and therefore boosts the likelihood of impaction. Obstructions in the path of eruption such as resistant to resorption of deciduous canine, presence of cysts, fibrous tissues, dense bone and supernumerary teeth. Arch length discrepancy from crowding or shortening of length can lead to buccal impaction (Jacoby, 1983). Brin et al., 1986, reported incidence of canine impaction is increased to 42.6% if lateral incisors are small or developmentally absent -since canine during its eruption takes guidance from roots of lateral incisors. Jacobs, 1996, stated palatal impactions are mostly due to the genetic reasons – common in some ethnic patients, females, twins and certain families.

Sequelae of an impacted canine is critical in understanding the significance of intervention ina timely manner. Some of these include labial or palatal malpositioning of impacted tooth, migration of neighboring teeth and loss in arch length, external root resorption of impacted and neighboring teeth, loss of vitality of incisors, infections, cyst formation, referred pain, damage to adjacent teeth during surgery, poor esthetics with over retained primary canines, ankylosis and internal resorption of canine. Therefore, it is critical a systematic approach be used to diagnose and classify the degree of impaction and the use of least invasive technique to help de-impact the canine and minimize the possible side effects. The canine bulge palpation from age 8 onwards is the most common recommended diagnostic tool, however, lack of positive palpation if only considered abnormal after age 10. (Becker and Chaushu, 2015) In addition, mobility and color of the deciduous canine should be visualized clinically. Supplementation by radiographs using one or combination of panoramic, periapical radiographs, lateral cephalometric, occlusal radiographs and/ or CBCT or medical CT scans may be required to confirm the clinical diagnosis.

Traditionally magnification technique was used which indicated palatal canines appear closer to source of x-ray and sensor is away from it. (Chaushu et al., 1999) however single image OPG overestimated angulation and proximity to midline is underestimated which is a major limitation of this technique and localization using parallax technique is preferred. (Ferguson, 1990) Parallax technique depends on tube-

shift principle or Clark's rule or SLOB: same lingual opposite buccal. 2 types of parallax techniques – horizontal or vertical. Diagnostic accuracy of horizontal is shown to be superior to vertical by Armstrong and colleagues (2003), showing 88% diagnostic sensitivity for horizontal compared to vertical parallax technique.

Canine impaction classification first described by Ericson and Kurol (1988a and 1988b) in both the frontal and transverse planes using axial vertex and panoramic radiograph. This was staged in 5 sectors shown in Figure 1.
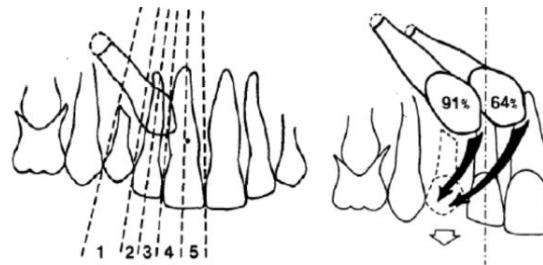

Figure 1: Canine impaction classification.

The above schematic illustration shows normalization of the maxillary permanent canine at the control 18months after extraction of primary canines (Ericson and Kurol, 1988a).

Since this classification several other classifications have been described in the literature.

a. 4 sector classification by Lindauer (Lindauer and colleagues, 1992)
b. 3 sector classification by Dr Crescini (Crescini and colleagues, 2007)
c. Sector classification by Stivaros and Mandall (2000)
d. Alpha angle as predictors of severity of impacted canine -Ericson and Kurol (1988b) - stated risk of root resorption of lateral incisor increased by 50% if angle greater than 25.
e. Beta & gamma angle as predictors of severity of impacted canine – beta angle described as angle between long axis of impacted canine to long axis of lateral incisor adjacent to it. Again, Ericson and Kurol (1988b) noted angle greater than 54 was difficult to manage. Guarnieri and colleagues (2016) have noted beta angle greater than 54 degrees having likelihood of root resorption is 61% or more. Therefore, root resorption predictability is substantially affected by beta angle.
f. Distance of canine's crown from occlusal plane as predictors of severity of impacted canine as described by Vermette and colleagues (1995) as the distance in mm from canine cusp tip to occlusal plane measured perpendicular. Stivaros and Mandall, (2000) graded the canine impaction to adjacent incisor.
g. Position of canine root apex anteroposteriorly as predictors of severity of impacted canine as graded by Stivaros and Mandall (2000).

There are various canine impaction classifications, and a simple approach would be to consider many of the above into a simple assessment, as the aim is to de-impact the canine with the least invasive

treatment approach. Pitt and colleagues (2006), McSherry (1996) and Stivaros and Mandall (2000) have simplified prognostic elements to be used in an index to assess and manage the severity of difficulty. The pictorial series below describes the index (Counihan and colleagues, 2013) [Figure 2].
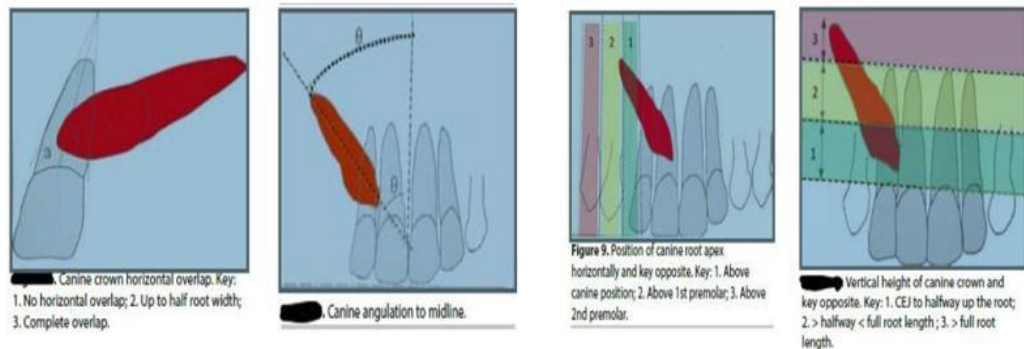

Figure 2: De-impact the canine with the least invasive treatment approach pictorial series of the index.

Management of impacted canines is critical, and the general dental practitioner is well positioned to identify early. Ericson and Kurol (1988a) have previously shown early extraction of deciduous maxillary canine can allow to de-impact canine and allow erupt in the correct position, this has been further extended to cases that are class 1 non-crowded. (Power and Short, 1993) Improvement in positioning with interceptive extraction to more favorable position was also reported [Figure 3].

Figure 3: Improvement in positioning with interceptive extraction to more favorable position.

Other options include do nothing (no active therapy) and monitor radiographically for any oral pathology like cysts, interceptive therapy – extraction of deciduous canine and expansion in the required dimension, surgical exposure and orthodontic therapy, surgical repositioning and extraction.

If timing for early intervention is lost and crowding or lack of space is noted, the need for multidisciplinary treatment arises and invasive therapy including surgery. Fixed anterior push sagittal appliance is a treatment modality which in current times has been advocated by Dr. Galella and the facial beauty institute (2023). They have recently modified the appliance to make it more hygienic and durable. It has been recommended to be used in patients over age 10 through adulthood to develop the

naso-maxillary complex and upright the mandible ramus through remodeling. This appliance takes advantage of the remodelling occurring in the facial region by influencing residual growth sites. Based on the current understanding of Craniofacial Biology, it is imperative that clinical treatment should progress in the direction of [Figure 4]:

Biology, it is imperative that clinical treatment should progress in the direction of:

- Normal facial balance o Nasomaxillary complex o Mandibular position o Symmetry
- Stable Class I cuspid occlusion
- table Temporomandibular Joints

And that the following be ideally achieved:

- Lip Seal (Competent lips and strong orbicularis oris)
- Nasal Breathing (Healthy airway)
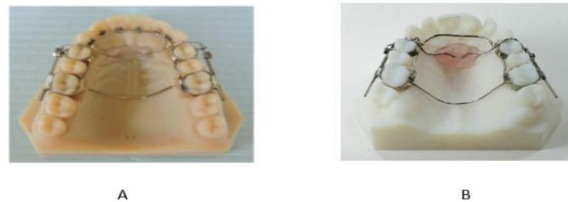- absence of Tongue Habits

Figure 4: A: MX Fixed Anterior Growth Guidance Appliance, Facial Version Generation 8 MX Fixed Osseo-Restoration™ Appliance, Facial Version Generation 8. B: MX Fixed Anterior Growth Guidance Appliance, Facial Version MX Fixed Osseo-Restoration™ Appliance, Facial Version.

These three attributes shall be referred to as the "BIG 3". It should be noted that the "BIG 3" represent more than just the three points indicated above. When achieving the "BIG 3" each patient is equalizing the complex forces of Craniofacial Biology including such factors as harmonious balance of extrinsic soft tissue influence, balanced growth, congruent function, and biological stability.

Conclusion

Larsen and colleagues (2010) have reported the maxillary complex to be significantly shorter in the sagittal dimension for ectopic canines. Dr Yosh Jefferson has presented Jefferson's analysis that is presented as a cephalometric analysis that is health and face centered, which is used to enrich facial attractiveness and in turn balance in facial proportions which would allow improvement in variety of health issues. (Jefferson, 2017) All cases presented below show maxillary retrognathism and developing the maxillary complex helps to de impact the ectopic canine and in addition facial proportions improved and supplemented by less stress for the clinician and suffering for the patient. Average to poor prognosis canine impaction cases were successfully de-impacted using fixed maxillary anterior push sagittal appliance, also known as the CD advancer, maxillary fixed anterior growth guidance appliance and maxillary fixed osseo-restoration (Galella, 2023) case 1 to case 5 given below [Figure 5 to Figure 27] (1-25).
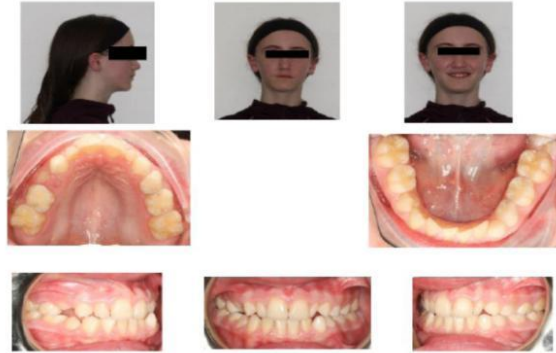
Case 1:

Figure 5: Maxillary retrognathism and developing the maxillary complex.

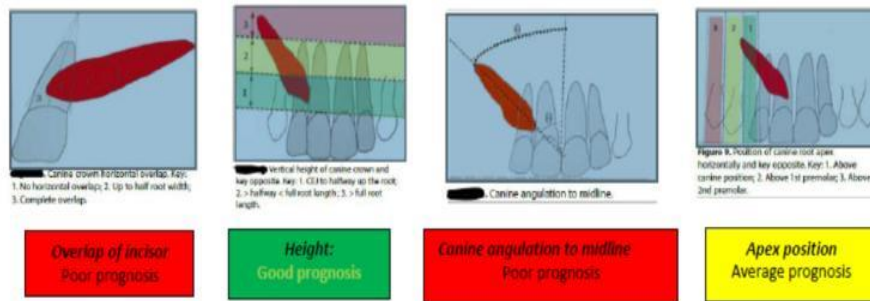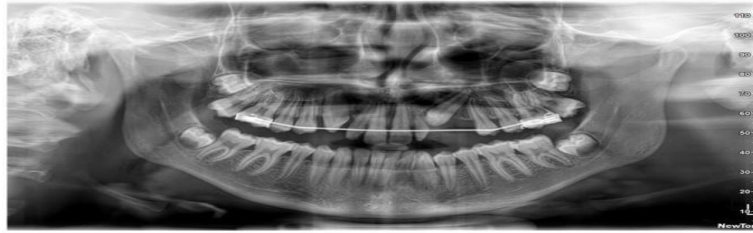**Figure 6:** Developing the maxillary complex.

Figure 7: De-impact the ectopic canine.

FITTING – JAN 2021 AND REMOVAL OCT 2021

Figure 8: Fitting and Removal.

UPDATED OPG – canine impaction improved significantly

Figure 9: Canine impaction ipmroved significantly.

Figure 10: Canines erupted naturally - Braces bonded.

Treatment Progress

Patient currently in treatment
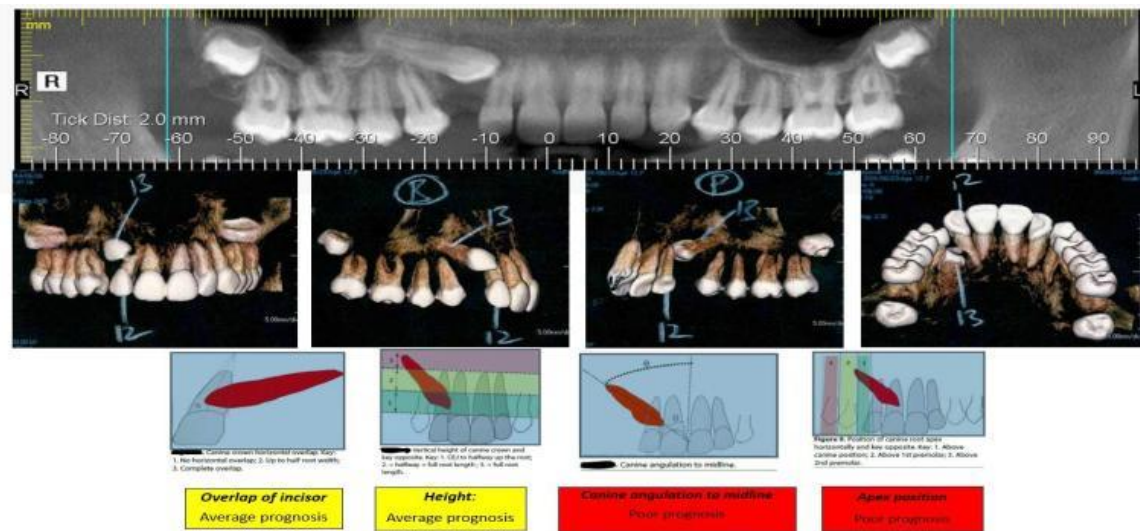
Figure 11: Treatment Progress.

Case 2:

Figure 12: Growth.

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Figure 13: Prognosis**.**

Figure 14: Fixed anterior push sagittal appliance.

Figure 15: Completion of the fixed anterior push sagittal appliance.
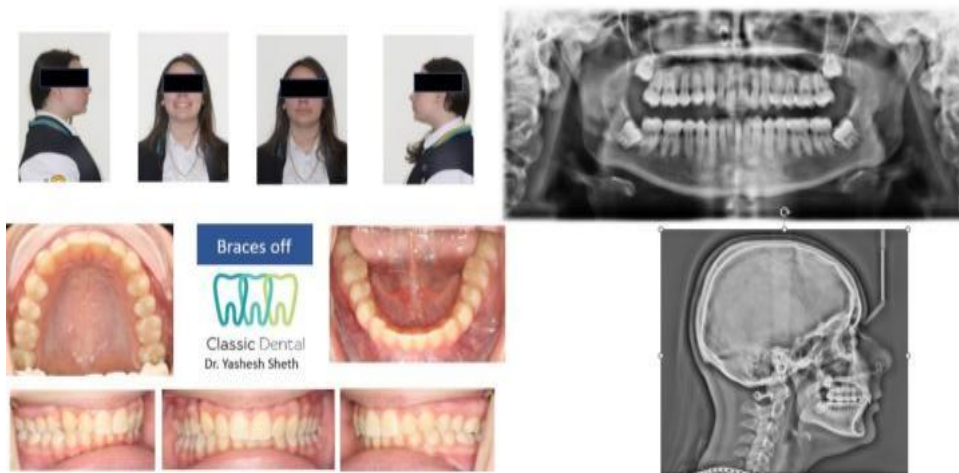
Figure 16: Treatment stages.

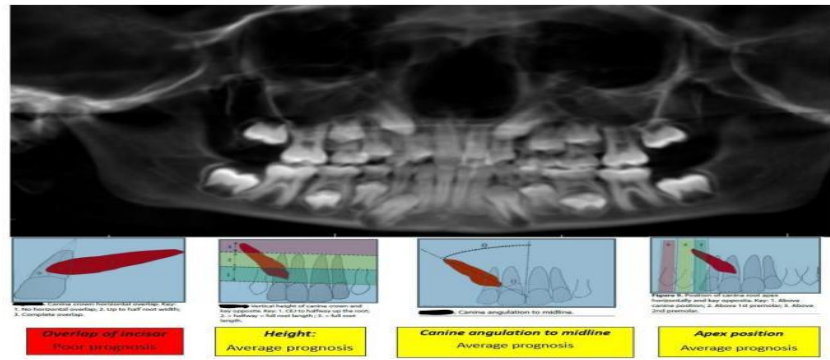**Figure 17:** Treatment images.

Case 3:

Figure 18: Overlapping.

Figure 19: Canine overlapping images.
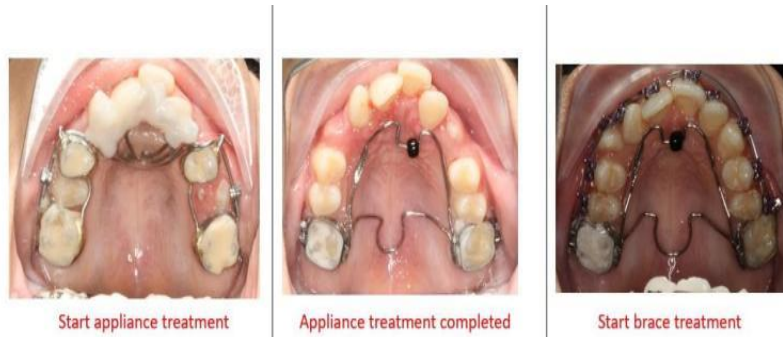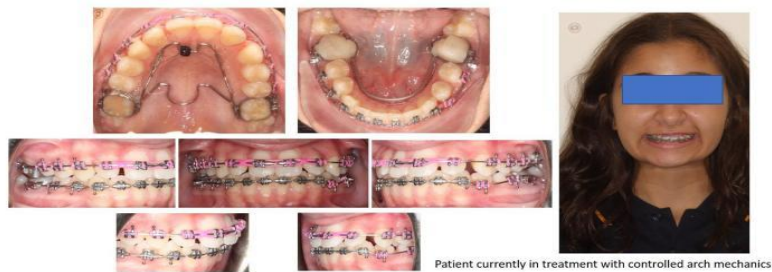

Figure 20: Appliance treatment.

Figure 21: Treatment growth.
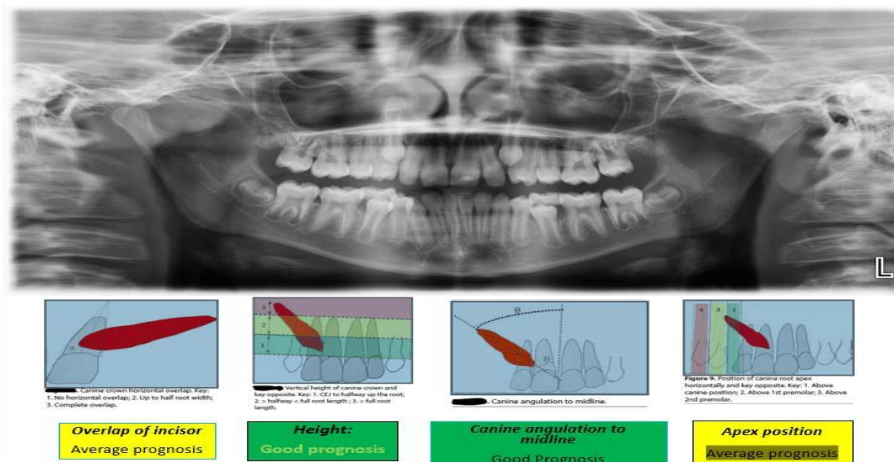
Case 4:

Figure 22: Treatment images.

Figure 23: Positioning.

Figure 24: Stages of treatment.

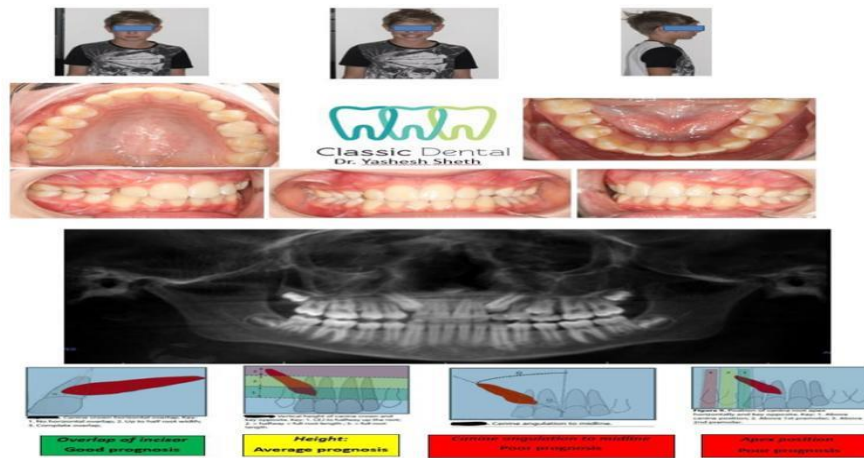**Figure 25:** Treatment Progress.

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Case 5:

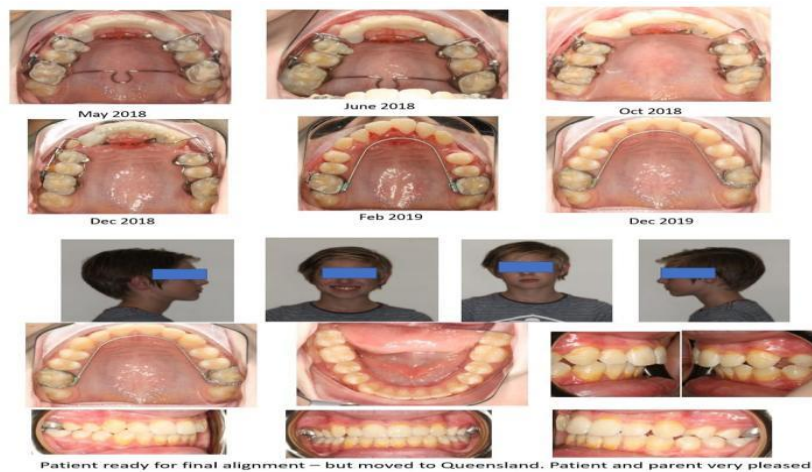**Figure 26:** Treatment stages and images.

Figure 27: Satisfactory final treatment results.

Summary

Impacted maxillary canines are extremely critical to be diagnosed earlier for easier and less invasive correction techniques as simple as extraction of deciduous maxillary canine. This article shows the efficacy of the fixed anterior push sagittal appliance that takes care of compliance issues regarding removable appliances and in addition to the maxillary complex with remodeling in cases of where the canine impaction prognosis for therapy was poor – average. These cases would have been managed otherwise with more invasive therapy involving extractions of teeth and possible damage to adjacent teeth. Stress to the clinician and suffering for the patients being the additional supplement. The general dental practitioner is well equipped with the clinical signs and radiographic assessments to help potential patients with early diagnosis.

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