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Exploring the potential of segmental T-loop in two different clinical situations

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ABSTRACT

This report describes the successful orthodontic treatment of two cases of highly placed canine with different clinical situations using segmental T-loop. The objective of this study was to evaluate the modification in T-loop on differently angulated canine. Orthodontic treatment of highly placed canine is justified as its aberrant position may damage the roots of adjacent teeth. In addition to it, functional occlusion and esthetic balance are achieved after orthodontic treatment. Malocclusion with severe crowding is difficult to treat without extraction as it compromises the patient's profile. Cases were managed with extraction of both maxillary and mandibular first premolars followed by Canine retraction with 0.017 in. × 0.025 in. TMA wire segmented T-loop spring using 0.022 in. × 0.028 in. (edgewise appliance). Different moments were applied for canine retraction at different axial inclinations. After treatment, satisfactory improvements in facial profile and lip competency with normal overjet and overbite without marked gingival recession and anchorage loss were observed.

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1. Introduction

Highly placed canines are frequently found condition in orthodontic practice and associated mainly with crowding. If highly placed canine with severe crowding is treated with non-extraction approach, it might result in proclination of maxillary and mandibular anterior teeth, and also have a harmful effect on the patient's soft tissue profile. By extraction approach it is much easier to correct the crowding and achieve stable results. In extraction approach frictional and frictionless mechanics can be used for space closure depending on the diagnosis and treatment plan. Frictionless loop mechanics of space closure is superior to frictional system as it allows greater control of tooth movement during space closure.[1] If cases with highly placed canine are treated with continuous wire; there is some intrusion of the anchorage unit, leaving a distorted occlusal plane.

Segmented T-loop retraction spring can be used for canine repositioning. Differential moment produced by T-loop is the method for anchorage control. The components of segmented T-loop like alpha (anterior) arm, beta (posterior) arm produce control force system in horizontal and vertical direction that

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has three-dimensional effect which can be managed by adjusting different parts of the loop.[2,3]

The objective of this paper is to highlight efficient use of segmental T-loop in the cases with highly placed canines and to discuss the effective retraction of highly placed canine with segmental T-loop.

2. Case 1

A 17-year-old female patient reported in the orthodontic clinic with the chief complaint of irregularly placed upper and lower front teeth. Patient had an apparently symmetrical leptoprosopic face, protrusive lower lip. The smile was symmetrical and nonconsonant. She had straight facial profile, oro-nasal breathing pattern with vertical growth pattern (Fig. 1). Intraorally she had permanent teeth up to second molars. A Class I molar and canine relation with crowding in upper and lower anterior teeth was present. Highly placed upper canines were present (Fig. 1).

Cephalometric analysis revealed that she had CVMI Stage 5, Class I skeletal bases, vertical growth pattern and proclined upper and lower incisors. The soft tissue analysis revealed protrusive lower lip and average nasolabial angle (Fig. 1). Panoramic radiograph showed full complement of teeth in maxillary and mandibular arch except 3rd permanent molar in all quadrant, which were in almost crown completion stage. Highly placed canines are mesially inclined on the basal bone (Fig. 1).

Model analysis showed that patient had V′ shaped arches with overjet and overbite of 0 mm and 10 mm crowding in upper and 9 mm crowding in lower arch.

Our objectives were to bring the highly positioned canine in occlusion, improve the facial profile, establish normal overjet



Fig. 1 – Case 1. Pre-treatment extra oral and intraoral photographs and radiographs showing crowding in upper, lower arch with highly placed upper canine and vertical growth pattern.

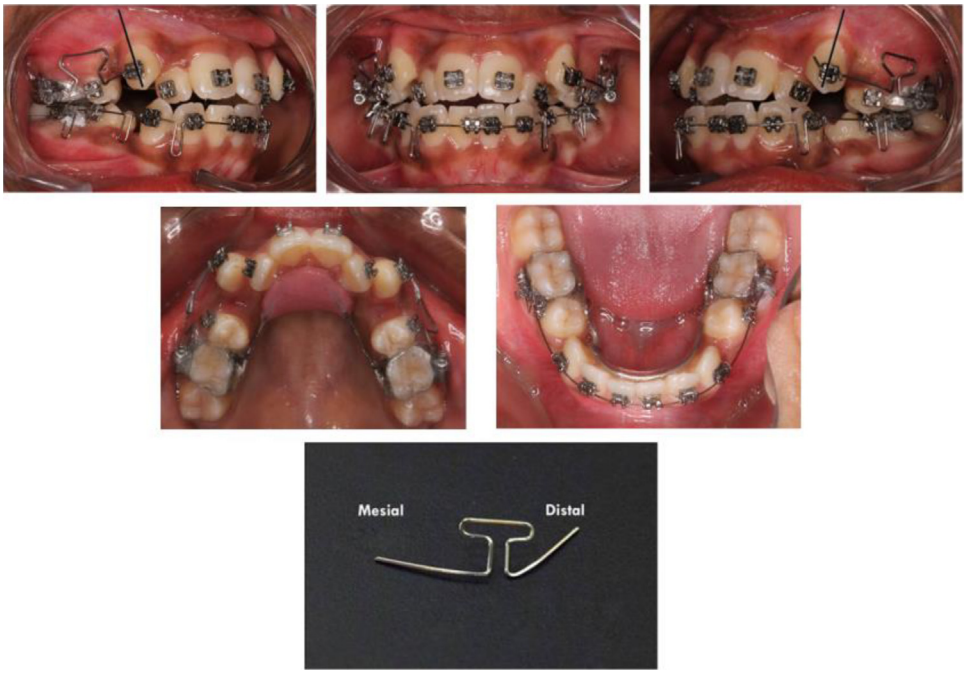


Fig. 2 – Case 1. Mid-treatment intraoral photographs showing (A) rigid 0.017 in. × 0.025 in. TMA segmental T-loop in upper arch, Nance palatal and translingual arch used for reinforced anchorage. (B) Customized T-loop without preactivation bend, for tipping movement of canine.

& overbite relieve crowding, maintain Class I molar and canine relation bilaterally.

2.1. *Treatment plan*

Fixed orthodontic treatment with extraction of all first permanent premolars using maximum anchorage in upper and lower arch was planned. The treatment was started after thorough oral prophylaxis with polishing of teeth. Standard edgewise appliance of slot size 0.022 in. × 0.028 in. was used followed by retraction of highly placed upper canines using 0.017 in. × 0.025 in. TMA wire (Fig. 2).

In this case canines crowns were tipped mesially and roots were tipped distally so tipping type of movement was desired. T-loop was used in this case as passive stage with just increase in a beta bend to maintain posterior anchorage, preactivation bend as described by Burstone[4] was not given because less moment was required for retraction. T-loop was initially 6 mm activated and further 2 mm activation after 1 month. Anchorage was reinforced by Nance palatal and translingual



Fig. 3 – Case 2. Mid-treatment intra oral photographs showing 0.016 in. ss wire in upper arch after canine retraction and 0.016 × 0.022 ss rectangular wire in lower arch.



Fig. 4 – Case 1. Post-treatment extra oral and intraoral photographs and radiographs showing highly placed canine in occlusion with normal overjet, overbite.

Table 1 – Treatment progress of two cases.

Variables	Case 1	Case 2
Prescription	Standard edgewise	Pre adjusted edgewise
Slot size	0.022 in. × 0.028 in.	0.022 in. × 0.028 in.
Anchorage reinforced by	Nance palatal and translingual arch	Differential moment
Highly placed upper canine retraction	Segmental T-loop in 0.017 × 0.025 TMA wire	Segmental T-loop in 0.017 × 0.025 TMA wire
Initial leveling and alignment	0.016 in. stainless steel wire with multiple loop in the upper and lower arch	0.016 in. stainless steel wire with multiple loop in the upper and lower arch
Lower arch space closure	Closing loop in 0.020 in. stainless steel wire	3/16 in., 4 ounce medium size Class II elastics in 0.018 in. × 0.025 in. stainless steel wire
Settling in	0.016 in. stainless steel arch wire with 1/8 in. light settling elastics	0.016 in. stainless steel arch wire with 1/8 in. light settling elastics
Retention	Upper and lower Begg's retainer along with lingual bonded retainer	Upper and lower Begg's retainer along with lingual bonded retainer

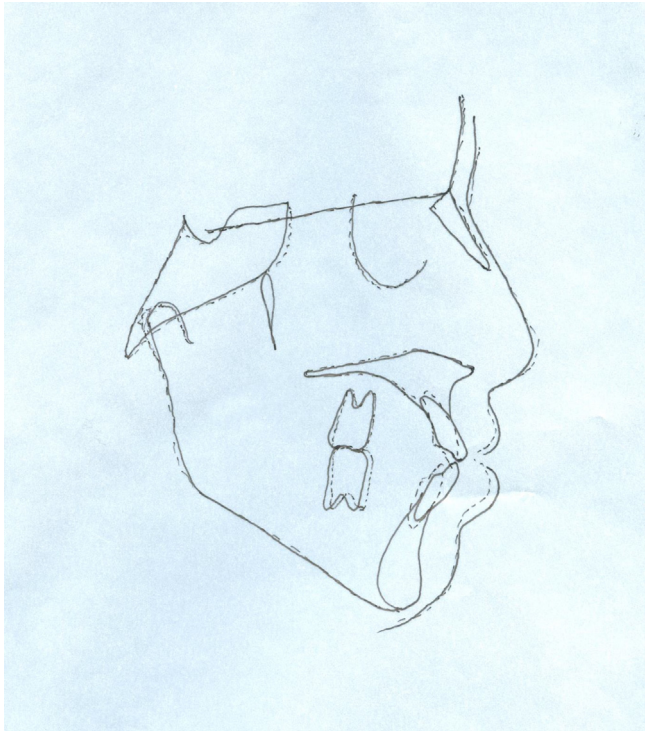


Fig. 5 – Case 1. Pre-treatment (solid line) and post-treatment (dashed line) lateral cephalogram superimposition.

arch in upper and lower arch respectively. It took three months to bring the highly placed canine in occlusion (Fig. 3).

After debonding, an upper and lower Begg's retainer along with lingual bonded retainer was delivered to retain the stable occlusion. Post treatment records of case 1 are shown in (Fig. 4) and lateral cephalometric superimposition in (Fig. 5) after the 1.7 years of start treatment.

The treatment of this case is described in Tables 1 and 2.

3. Case 2

14-year-old male patient reported in the orthodontic clinic, with the chief complaint of irregularly placed upper and lower front teeth. Patient had an apparently symmetrical leptoprosopic face with a symmetrical and nonconsonant smile (Fig. 6).

Intraorally, he had all permanent teeth up to second molars, increased overbite, Class II molar and canine relation bilaterally. The gingival health was satisfactory and adequate zone of attached gingival was present. There was maxillary midline shift 2 mm toward left with crowding in upper and lower anteriors. The lower right canine was mesiolingually rotated. Upper canines were highly placed with lingually placed upper left lateral incisor (Fig. 6).

Cephalometric analysis revealed that the patient was in CVMI Stage 3 and had Class I skeletal bases, vertical growth pattern, normal interlabial gap. The soft tissue analysis revealed normal lip relation with normal nasolabial angle (Fig. 6).

Panoramic radiograph showed full complement of teeth in maxillary and mandibular arch except 3rd permanent molar in all quadrants, which were in almost crown completion stage. Highly placed canines are upright on the basal bone (Fig. 6).

Model analysis showed that patient had overjet of 1 mm and overbite of 3 mm with 14 mm crowding in upper arch and 8 mm crowding in lower arch.

3.1. *Treatment objectives*

Objectives were to bring the highly positioned canine in occlusion, improve the facial profile, establish normal overjet, overbite and relieve crowding, achieve Class I molar and canine relation bilaterally.

3.2. *Treatment plan*

It was planned that the case has to be treated with orthodontic treatment with extraction of all first premolars. Treatment was started after thorough oral prophylaxis with polishing of teeth. Standard edgewise appliance of slot size 0.022 in. × 0.028 in. was used followed by retraction of ectopically placed upper canines using 0.017 in. × 0.025 in. TMA wire. Axial inclination of canines in this case was in upright position but it was labially and highly placed and translatory type of movement of canine was desirable. Preactivation bend incorporated into

Table 2 – Measurements of cephalometric parameters.

Parameters	Case 1		Case 2	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
UI-SN	109°	102°	97	114
UI-NA (linear, mm)	4 mm	0 mm	3 mm	8 mm
UI-NA (angular)	31°	20°	14°	30°
LI-NB (linear, mm)	8 mm	3 mm	3 mm	4 mm
LI-NB (angular)	32°	13°	25°	20°
IMPA	96°	85°	90°	85°
SN-GoGn	36°	35°	33°	34°
Nasolabial angle	99°	100°	108°	102°
Upper lip to E-line (mm)	−1 mm	−3 mm	1 mm	0 mm
Lower lip to E-line (mm)	−4 mm	−1 mm	−3 mm	−5 mm



Fig. 6 – Case 2. Pre-treatment extra oral and intraoral photographs and radiographs showing crowding in upper, lower arch with highly placed upper canine, with lingually placed upper left lateral incisor and vertical growth pattern.

alpha and beta arm to increase moment for translation (Fig. 7) but keep in mind that force should be below the 300 g that is required for molar protraction. When we activate the loop first movement is tipping then translation followed by root correction because during retraction progression force decrease and M/F ratio increased. Initially T-loop was 6 mm activated. During retraction when cuspid crown move distally and it touches the second premolar, tie back given from molar to hold the crown distally then root correction occurs. It took four months to bring the highly place canine in occlusion (Fig. 8).

Post treatment records of case 2 are shown in Fig. 9 and lateral cephalometric superimposition in Figs. 10 and 11 after 1.5 years of start treatment. After debonding, an upper and lower Begg's retainer along with lingual bonded retainers were issued to retain the occlusion.

The treatment of this case is described in Tables 1 and 2.

4. Discussion

In the present paper, the segmented T-loop spring was chosen for canine retraction and it is expected that this T-loop will deliver a relatively continuous light force of appropriate duration, and apply moment of proper magnitude to prevent tilting and rotation of a tooth. The force system produced by T-loop springs depends on many variables, including wire size and material, spring shape (preactivation shape), spring



Fig. 7 – Case 2. Mid-treatment intraoral photographs showing (A) rigid 0.017 in. × 0.025 in. TMA segmental T-loop in upper arch. (B) Customized T-loop with preactivation bend, for translation movement of canine.

position, and activation. Orthodontist determine the force magnitude, direction, moment-to-force ratio, and force constancy during treatment.[4] Depending on the axial inclination of canine, different displacement patterns such as controlled tipping, translation, and root movement distally are described.[5] It is believed that the given initial load system with certain moment/force ratios (M/F) can control displacement patterns during the retraction of the highly placed canine, the segmented T-loop applied not only a distal force on the canine with active cinch back, but also a moment for anti-distal tipping as well as torque control of the canine produced by bending of the mesial horizontal portion on the full size 0.017 × 0.025 TMA wire. By using sectional T-loop during retraction, the highly placed canine was separated from the root of the adjacent lateral incisor and steadily moved distally toward the proper antero-posterior position. Later a vertical force on the canine become more desirable and the segmented arch exerts an extrusive force to bring the



Fig. 8 – Case 2. Mid-treatment intra oral photographs showing 0.016 in. ss wire with multiple loop in upper and lower arch after canine retraction.



Fig. 9 – Case 2. Post-treatment extra oral and intraoral photographs and radiographs showing highly placed canine in occlusion with normal overjet, overbite and achievement of Class I molar and canine relation.

canine toward the occlusion. When canine is retracted with T-loop on its labial surface; there is a distal in, mesial out rotation tendency. To reduce distal in mesial out tendency on canine retraction with T-loop, an antirotation bend was given in these cases and canines are also labially placed in these cases so beta first order antirotation bend were increased to bring it in occlusion.

We achieved better results by modifying alpha and beta arm of T-loop and position of T-loop. In these cases we keep the T loop close to molar tube to increase the anchorage in posterior unit. In case 1, tipping type of canine movement is desired with less M/F ratio, preactivation bend is not given in T- because these bend increase the moment so M/F ratio increases. For case 2 translation type of movement is desired, so preactivation bend is required to increase the moment and M/F ratio.

T-loop fabricated in 0.017 × 0.025 in. TMA wire is expected to deliver 250 g of force to produce canine retraction at the rate of 0.87 mm/month.[6] TMA is a material of choice for its excellent spring-back properties coupled with good formability. It can be easily contoured and helix is not required in T-loop like stainless steel wire. The loop should be designed to incorporate additional wire length in apical part to increase the M:F ratio, which facilitates the translation of the canine. In segmented arch mechanics, canine retraction T-loops has been used to control the anchorage during space closure by modulating moments of the posterior teeth/part of the T-loop.[7,8]

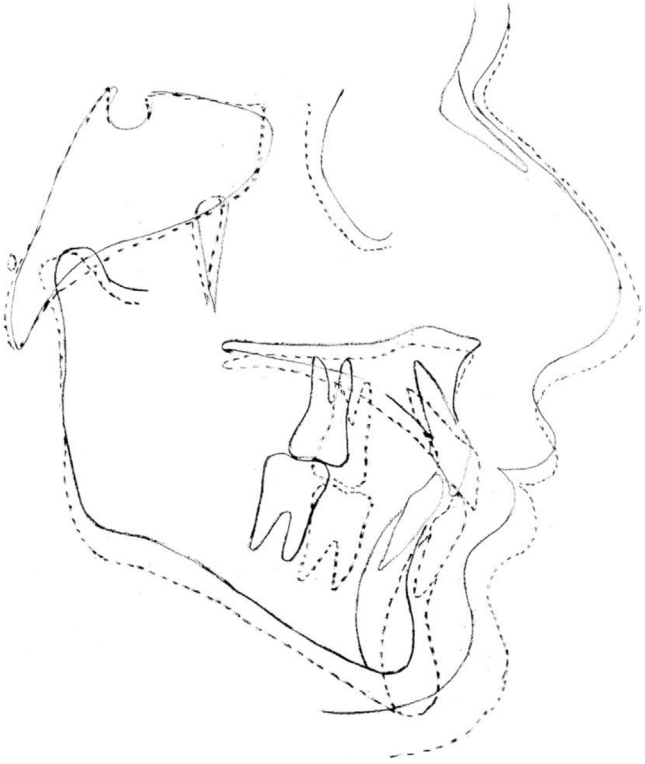


Fig. 10 – Case 2. Pre-treatment (solid line) and post-treatment (dashed line) lateral cephalogram superimposition.

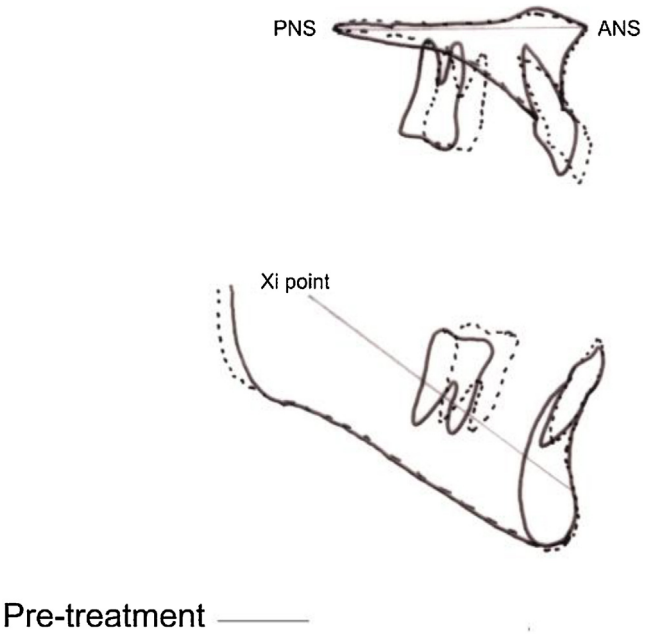


Fig. 11 – Case 2. Pre-treatment (solid line) and post-treatment (dashed line) lateral cephalogram regional superimposition.

5. Conclusions

Our results showed that if highly placed canines of different clinical situations treated using different modification in segmental T-loop; predictable results with minimal side effects can be achieved.

Conflicts of interest

The authors have none to declare.

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