

## Y- Spring, innovative mechanics for 3-Dimensional correction of unilateral unfavourably angulated buccally blocked canines

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### ABSTRACT

**Background:** The canine, being the cornerstone of the dental arch, needs to be placed in a stable position to fulfill its role in functional occlusion. The problem with unfavorably angulated canines is that the crown of the canine is distal and the root is mesial. This issue, when associated with anterior crowding, is a concern in treatment planning, as engaging a continuous wire can be detrimental by deepening the bite during the leveling and aligning stage. The Y-Spring is a Pre-Stage 1 cantilever spring designed to correct unilateral unfavorable angulations of canines before engaging a continuous Stage 1 arch wire to address severe cases of crowding with ectopic, buccally blocked canines. It is fabricated by custom wire bending on a rectangular wire, preferably a 17x25 Beta Titanium wire, featuring a combination of a box loop and hook incorporated onto the extension of the box loop, close to the center of resistance of the canine. Its versatility allows for adaptability in eliciting a 3-dimensional movement of canines.

**Keywords:** Unfavourably angulated, ectopic canine, cantilever spring, pre-stage 1, Y-Spring.

### INTRODUCTION

The morphology of canines, characterized by their long roots and a complex eruption path, makes them prone to ectopic eruption. Warford et al. have proposed measuring the sector and the angulation of the long axis of canines plotted against the bicondylar line on panoramic X-ray to predict the prognosis of ectopic correction canines<sup>1,2</sup>. The problem with unfavorably angulated canines is that the crown of the canine is distal, and the root is mesial. If this condition is associated with anterior crowding, it raises concerns regarding treatment planning. Segmental arch techniques allow for the use of pre-fabricated cantilever springs, which are precalibrated to produce the desired retraction, uprighting, and vertical movement of teeth. The

most documented cantilever spring is Burststone's T-Loop, followed by the PG retraction spring<sup>3</sup>. Opus loop is a new canine retraction mechanism that has a low load deflection rate, used to elicit bodily retraction of canines during space closure. A specific mention of uprighting unfavorably angulated canines as a prerequisite step before the alignment phase is not included in the literature.

Y-Spring, a Pre-Stage 1 cantilever spring, is designed to correct the unilateral unfavourable angulations of ectopic buccally blocked out canines, prior to engaging a continuous Stage 1 arch wire, after correcting its angulation and ectopic position in severe cases of crowding. It is fabricated by

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customised wire bending on a rectangular wire, preferably a 17x25 Beta Titanium wire, with a combination of box loop & hook incorporated in the vertical extension of the box loop placed closer to

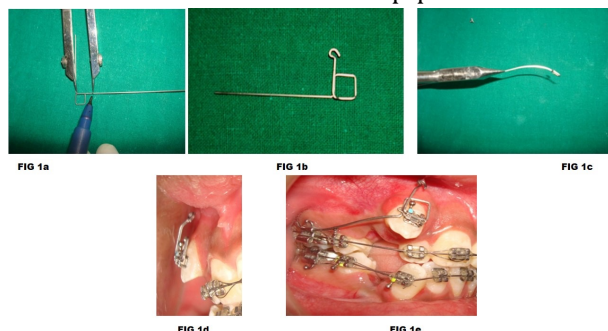


Figure 1: Steps in the Fabrication of Y-Spring.

Step 1: Prepare the BOX part of Y-SPRING as you would when fabricating a box loop.

Step 2: Measure the distance from the bracket slot to the Center of Resistance of the canine; transfer the distance 'x' to the vertical section of the wire above the box loop as shown in (Fig 1a).

Step 3: Check the customized Y-Spring, which has no pre-activation bends (Fig.1b), to ensure there is no first-order discrepancy in the finished box part of the Y-Spring, which extends as a vertical hook measuring 'x'.

Step 4: Apply the compensatory bend, as shown in (Fig.1c), to ensure that the spring is in the Neutral zone.

Step 5: Pre-activate the spring in 3 dimensions to match the treatment objectives, as shown in (Fig.1d).

Step 6: Tie the Y-spring onto the canine bracket and cinch it so that the moments are expressed (Fig.1e).

## CASE REPORT

### Clinical cases

#### Case 1

A case of severe crowding with 90° distobuccal rotation of the lower left lateral incisor and a buccally blocked out and unfavorably angulated lower left canine is presented (Fig. 2a). Post-extraction of the first premolars, a 0.022 PEA Appliance with MBT Prescription was provided.

the centre of resistance of the canine. Its versatility can be used and can be adaptable in eliciting a 3-dimensional movement of canines<sup>3-5</sup>.

Anchorage preparation was accomplished by placing a lingual arch and preparing a left posterior sectional wire traversing the first molar and second premolar. A customised Y-Spring was fabricated with a 17x25  $\beta$ -Titanium wire and engaged with a tight ligature onto the canine, cinched to create the moments (Fig 2b). Notable improvement in the angulation of the canine was observed after an elastic chain was engaged from the molar to the hook of the Y-Spring four weeks after its placement, as part of Pre-stage 1 mechanics (Fig 2c). The case was simultaneously completed by sliding mechanics with a 19x25 SS posted arch wire (Fig 2d) (Fig 2e). The total treatment time from start to finish was 20 months with Pre-stage 1 mechanics, with a Y-spring given for 3 months out of a 7-month-long levelling and aligning phase.

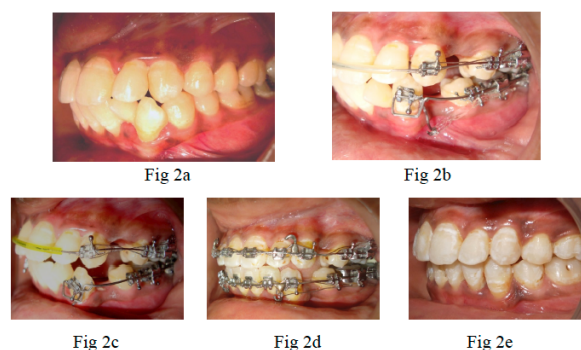


Figure 2: Treatment steps of case 1.

#### Case 2

A similar type of crowding with a unilateral unfavorably angulated canine and a full cusp class II molar relation (Fig. 3a,3b,3c) was treated with asymmetric extractions of the upper first premolar in the second quadrant and the lower second premolar in the third quadrant. Pre-stage 1 mechanics with a Y-spring fabricated from 17x25  $\beta$ -Titanium wire were applied for four months to align the canine (Fig 3d). This was later incorporated into continuous archwires on a 19x25 SS working archwire (Fig 3e). The case was simultaneously completed with a good post-treatment result (Fig 3f,g).

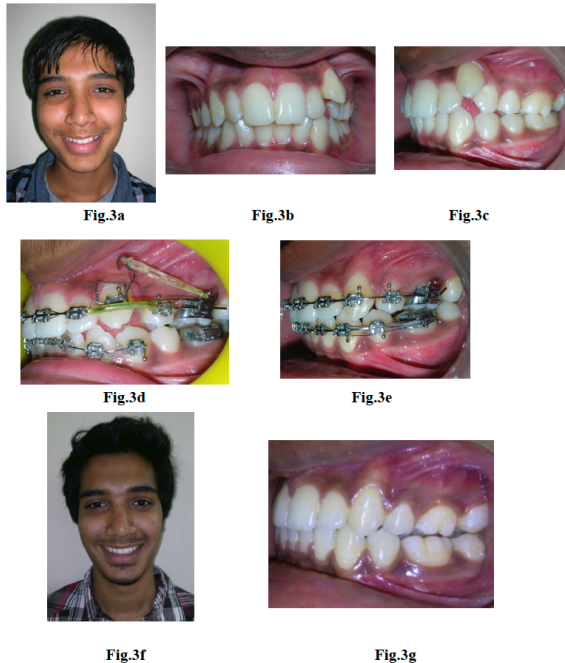


Figure 3: Treatment steps of case 2.

## DISCUSSION

The versatility and ease of using the Y-spring lie in its ability to function as a pre-stage 1 correcting spring, designed to correct unfavourably angulated canines using the cantilever principle. The rapid correction of unfavourably angulated canines can be achieved within 3-4 months, facilitating a smooth transition to sliding mechanics later on for en-masse retraction. This pre-stage 1 alignment with the Y-spring aims to prevent round tripping that can create a deep bite due to the extrusion of anteriors by engaging a continuous aligning archwire in cases with unfavourable angulations of canines to start with <sup>6</sup>.

Y-spring can serve as an auxiliary spring, with the posterior leg engaged in an auxiliary slot, as seen in cases 2 and 2,3, or the posterior leg can be engaged in the molar and premolar slot, as observed in case 1. It is recommended to move the canine in three dimensions in cases with unilateral buccally blocked ectopically erupted canines that exhibit unfavorable angulations. Applying elastic traction from the implant placed in the premolar and molar regions onto the hook of the Y-spring can reduce the counter moments generated on the posterior anchor unit. Although patients may find the inconvenience of having a hook incorporated in the Y-spring, careful placement of compensatory bends

to position the hook in the neutral zone has been well tolerated by them. Care should be taken not to tie the posterior leg of an auxiliary Y-spring to the premolar, as this creates a significant palatal cusp overhang of the premolar <sup>5</sup>.

## CONCLUSION

Y-Spring is a Pre-Stage 1 cantilever spring designed to correct the unilateral unfavorable angulations of canines before engaging a continuous Stage 1 arch wire to address severe cases of crowding with ectopic, buccally blocked-out canines. Its versatility can correct the canines in three dimensions. The recommended wire for fabrication is 17x25  $\beta$ -Titanium wire in a 022 slot PEA or 16x22  $\beta$ -Titanium in a 018 slot, which can deliver lighter forces with more range and enhanced biomechanics.

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