Versatile Auxiliary Orthodontic Spring for Orthodontic Correction of Impacted Teeth

Pavankumar Janardan Vibhute

ABSTRACT

Malocclusion such as impacted tooth is not uncommon. Many approaches with various auxiliary springs have been reported in literature till date for correction of such malocclusions. They had biomechanical, retentive and stability drawbacks inherent in their designs. This article presents the innovative approach for orthodontic correction of impacted tooth, especially with light force appliance, i.e. Begg’s appliance, where round wires in round molar tubes are used throughout treatment. A versatile auxiliary orthodontic spring (VAOS) is fabricated in the 0.018 inch Australian stainless steel round wire, which may be anchored on round molar buccal tube, and desirable force vector may be applied in any of the three dimensions. Fabrication and its clinical application are discussed.

Keywords: Auxiliary orthodontic spring, Impacted tooth, Impacted canine, Cantilever spring, VAOS.

How to cite this article: Vibhute PKJ. Versatile Auxiliary Orthodontic Spring for Orthodontic Correction of Impacted Teeth. J of Ind Ortho Soc 2011;45(1):40-47.

INTRODUCTION

The ectopic eruption and impaction of permanent canine is a frequently encountered clinical problem. Lowest incidence of impacted canines 0.27% reported in literature relates to Japanese sample population.1 In Americans2,3 and Israeli,4 it is 1.5% while the highest incidence of 7.9% was reported among Iceland population.5 Maxillary canine, since last in eruption sequence (except third molars), is most prevalent to be malpositioned due to tooth size arch length discrepancy (TSALD).

Auxiliary springs have been used in orthodontics since long for the correction of impacted or unerupted canines or adjacent teeth. Cantilever springs are preferred than the continuous wires as placement of continuous flexible wires for correction of these single tooth malocclusions produces adverse effects on adjacent teeth, i.e. flattening of the arch and/or openbite in that region which eventually require more time for correction.

In Begg’s light force appliance, various methods have been used, including the use of light wire springs, springs soldered to the heavy labial or palatal base wire and mousetrap loops bent in the archwires. With the use of these methods orthodontist had no precise control of magnitude and direction of force.6 Ballista spring,7 a unilateral spring made up of round wire and is tied into one of the molar tube, lacks the versatility in its use. Seong-Sang used auxiliary wire comprising 0.014 inch Australian Willcock wire.8 In 1995, Kornhauser et al used labial spring auxiliary.9 Orton in 1995 used a combination of the lower removable appliance and gold chain since this can be readily fabricated.10 Magnets are also utilized for the correction of impacted canines.11 Bowman and Carano introduced the Kilroy spring in 2003.12 Auxiliaries used previously lacked the versatility of their use with different fixed appliances, such as round and rectangular molar tubes and were not applicable for different malpositions of the canine or adjacent teeth. Their uses were restricted to specific conditions.

Present article describes the fabrication of a self-stabilizing, self-locking, versatile auxiliary orthodontic spring (VAOS).

FABRICATION

A 0.018 inch round stainless steel wire (Australian), ribbon arch plier, E-4 plier, distal end cutter, scale and marking pencil are needed for fabrication of this spring.2

1. Take 8 cm straight length piece of wire and bend it to form a long loop of 1 mm width with one long and one short arm. Length of short arm should be at least 22 mm while that of long arm should be at least 58 mm. In following steps, long arm will be used to prepare an active cantilever arm while short arm to prepare retentive framework (Fig. 1).

2. Fold 5 mm length of loop to about 60° with respect to rest of the wire arms (Fig. 2).

3. Molar buccal adaptation curvature is prepared in 6 mm loop span in long and short arm immediate adjacent to 5 mm loop. This 6 mm curved span of wire arms further forms...
the stabilizing arms in the retentive framework of the spring (Fig. 3).

4. Bend the long arm to crossover short arm by about 60°-70° from the side of previously folded loop. Therefore, span between crossover point and 5 mm loop section is about 6 mm molar buccal adaptation curvature (Fig. 4).

5. Now, bend the short retentive arm perpendicular to the middle curved wire segments and towards the same side and same direction of the previously folded portion of the loop (Fig. 5).

6. Tip of short retentive arm is held and pulled by deflecting it to engage it within the ‘5 mm loop’ and while doing so slight deflection of 5 mm loop away from short retentive arm is necessary without its permanent deformation (Fig. 6). If the length of short retentive wire arm is in excess, it needs to be precut before engaging it inside 5 mm loop. Usually length of 10 mm would suffice.

7. Hold 5 mm loop segment firmly as close as possible to stabilizing arm with the help of ribbon arch plier while complete deflection of retentive arm towards stabilizing arms, i.e. opposite side of the ribbon arch pliers beak, and give 90° bend to the loop towards long active arm side. With completion of this bend, retentive framework has short retentive arm with free distal end and surrounded by the 3 mm buccal loop part, 2 mm distal loop part and 6 mm stabilizing curved arms. Placement of this bend is very crucial for its precision. Finally, retentive framework is ready for its insertion into molar tube (Figs 7A to 8).

8. Tip of short retentive arm is held with weingart plier for insertion into molar tube. With insertion of the retentive short wire into molar tube, the frame is self stabilized by one curved wire segment of loop spreading occlusal and the other gingival to the tube (Fig. 9).

9. After deciding the proper length of active arm an eyelet is prepared at its end for engaging the attachment which is bonded on the malposed tooth. The active arm is simply deflected in the direction in which traction of impacted tooth is to be given. With the complete insertion of retentive arm in the molar tube, bend back or cinch back bend should be given to prevent the dislodgement of spring mesially (Figs 10A and B).

10. In some modifications, helical coil is incorporated in long active arm near to retentive framework for increasing resilience in buccolingual or occlusogingival direction.
Plane of helix is decided according to the direction of force required for correction of tooth (Fig. 11). Vertical loop may be incorporated in long active cantilever arm to control or alter the mesiodistal movement of malposed tooth.

CASE REPORTS

Case 1

Diagnosis and Treatment Plan

A 20-year-old male patient reported with the chief complaint of midline diastema and left canine crossbite. On clinical examination, over-retained deciduous maxillary right canine anterior spacing was observed. Radiographically, impaction of maxillary left canine revealed, which was 11 mm above occlusal level (Fig. 12). Treatment plan called for overall extraction of deciduous over-retained canine. Position and angulation of impacted canine was found favorable and the orthodontic traction of same was planned.

Treatment Progress

Both arches strapped up with Begg’s appliance. With temporary bite raising crown on lower molars, the crossbite of left maxillary canine was relieved. After alignment and consolidation of maxillary arch, over-retained deciduous canine was extracted and the impacted canine was exposed surgically as per the protocol suggested by Becker. A bracket was bonded on the impacted canine and the flap was repositioned (Fig. 13A).
ligature wire was attached to the bonded bracket before repositioning the flap and its free ends were extended outside the flap (Figs 13B and C). On the right side of maxillary base archwire (0.018 inch Australian stainless steel) 15° anchor bend mesial to the molar tube was incorporated where the VAOS was to be placed. Since occlusal traction of impacted canine with VAOS has mesial tipping force on the anchor molar that effect must be nullified with an anchor bend in the base archwire. A VAOS, made from 0.018 inch Australian SS wire, was placed on the right maxillary 1st molar tube. The active arm was set to exert an occlusal pull of about 2 to 3 ounces (Figs 13D and E). Hook of the active arm of the VAOS was ligated to the bracket on the impacted tooth with the ligature wire extended outside the flap. The canine was brought in to normal occlusion without adverse changes on the anchor molar in the 6 months (Fig. 14).
Fig. 11: Helical coil incorporated in long active arm for increasing resilience in buccolingual or occlusogingival direction

Fig. 12: Pretreatment photographs

Figs 13A to C: Exposure and placement of VAOS
Versatile Auxiliary Orthodontic Spring for Orthodontic Correction of Impacted Teeth

Figs 13D and E: Exposure of impacted canine and VAOS placement

Fig. 14: After complete traction of impacted canine

Fig. 15: Post-debonding photographs
There was no evidence of soft tissue irritation, distortion of spring or adverse effects on the six adjacent teeths. Upper wraparound and lower Hawley’s retainer were delivered for retention.

**Treatment Results**

After 12 months of treatment patient showed normal overjet, overbite, coinciding midlines and a good Class I relation of the canines and molars. Smile and overall esthetics of the patient was improved (Fig. 15).

**Case 2**

A 24-year-old patient reported with an impacted left maxillary canine. Position of the canine was evaluated from occlusal and panoramic radiographic examination. Prognosis for the canine was found favorable for orthodontic traction. Rest of the dentition was fairly well-positioned. The traction required for the canine was in a labial and occlusal direction. Part of the canine was exposed surgically as per protocol suggested by Beker\textsuperscript{13} in 1998 and bonding of attachment (bracket) was done on it. Finally, decision was to place the auxiliary orthodontic spring made in 0.018 inch round wire. A 0.018 inch Australian base arch wire was placed with toe-in and anchor bend incorporated on the side where VAOS was to be placed. Active arm was set to exert of labial and occlusal directional pull of about 2 to 3 ounce, which was confirmed by tension gauge 8 analog. Mesial tipping and mesiopalatal rotational effect on the anchor molar exerted by the spring were nullified by toe-in and anchor bends. Hook in the active arm was ligated to the attachment on exposed canine with ligature wire. After four months of active treatment, the canine was brought in proper alignment in the arch without any adverse changes on the anchor molar (Fig. 16).

**DISCUSSION**

Until now, preparing the spring in round wire had not been attempted which can be anchored or secured in both the round or rectangular molar tube along with the base arch wire. The insertion of the retentive arm of this spring into the round buccal tube engages the buccal tube from the cervical, occlusal and buccal aspect, the elasticity of this versatile spring causes it to exert a force when it returns to its original/neutral position, which resultantly applies an optimum force in a desired direction to the impacted tooth. Magnitude and vector of the force exerted by cantilever arm may be controlled in all three dimensions. Force level recommended for extrusion of impacted tooth range from 60 to 75 gm, which is easily attained with this type of spring. Force may be adjusted according to the type of movement required. This spring has less adverse effects on the adjacent teeth than the use of continuous flexible archwires. Furthermore, this spring can be used even if the malocclusion is limited to a single tooth, i.e. this type of spring does not require fully bonded appliance unless full arch corrections are warranted, rather treatment can be carried out without placement of complete bonded appliance on all teeth except first molar which are supported with a transpalatal arch. Adverse forces,
tipping, and torquing movements on anchor molars may be controlled with a transpalatal arch between the two molars. Thus, it has wide range of applicability with the appliances having round molar buccal tube of dimensions 0.036 inch × 0.25 cm.

Advantages

1. Design of the spring is unique in such a way that although it is prepared in round wire and engaged in round molar tube it does not rotate or destabilize
2. It has wide range of clinical applicability with the appliances having round molar buccal tube of dimensions 0.036 inch × 0.25 mm, i.e. Tip edge appliances, Begg’s appliance and rectangular buccal tubes
3. Versatility of spring’s unique design allows it to be used in various conditions of correcting single tooth malposition in any arch, e.g. blocked-out canine or palataly impacted canine or premolar
4. Adverse effects on adjacent teeth are eliminated because no reactionary forces exerted on adjacent teeth
5. Light controlled and continuous force is generated by this spring to work over a long range of movement to bring the tooth to desired position
6. Two springs with active arms placed opposite in direction to each other can be used for correction of canting of occlusal plane
7. Its use can be extended for uprighting of the molars
8. Such type of spring can be removed and replaced without disengaging the continuous base archwire
9. More economical than any other previously reported approach. Spring may be prefabricated and kept in stock. Thus, reduce the chairside time while treating the patient.

REFERENCES