Case Report

Dental midline correction using a cantilever spring: A novel approach

ABSTRACT

A 13-year-old patient presented with Angle's Class II subdivision right malocclusion with anterior crowding, protruded lower incisors, and a lower arch that was skewed to the left. A morphological lower midline shift of 3 mm to the left was detected. Following extraction of the upper and lower first premolars, full-arch 0.022" MBT™ appliances were placed in both arches. A 0.018" 0.025" stainless steel archwire was split into two posterior segments and an anterior segment from the right lateral incisor to the left canine including an open vertical helical loop extending apically toward the center of resistance of the consolidated anterior segment. Subsequently, a 0.017" 0.025" titanium–molybdenum alloy cantilever spring from the right first molar auxiliary tube was bent buccally and connected to the loop with an elastomeric chain to achieve lower midline correction by translation. Midline correction with the use of segmented-wire technique and cantilever spring provides an effective method of incisor movement by translation with minimal side effects.

Keywords: Cantilever spring, Class II malocclusion, dentoalveolar asymmetry, midline

INTRODUCTION

Midline discrepancies, manifesting as asymmetries in arch form, represent a significant component of all malocclusions among orthodontic patients. The origin of these discrepancies may be dentoalveolar, functional, skeletal, or a combination of these.[1] Abnormal dental eruption, asymmetric crowding, spacing, tooth rotations, displacement, and distortion of the upper or lower dental arches, are the myriad causes of midline asymmetries of dental origin.[2,3]

Midline asymmetries are more frequently observed in Class II malocclusions.[4] Class II subdivision malocclusion usually represents a classic orthodontic asymmetric malocclusion,[5] wherein a Class I occlusion is observed on one side and a Class II occlusion on the other side, with the upper and lower midlines not coinciding with each other or the facial midline.

Management of midline asymmetry often poses a therapeutic challenge. Myriad treatment modalities such as asymmetric mechanics, asymmetric extractions, mini-screw anchorage, and surgical correction have been recommended for the correction of midline discrepancies. The present case report describes the management of a case with midline asymmetry using a novel approach and a predictable force system.

CASE REPORT

A 13-year-old patient presented with the chief complaint of an unpleasant smile and crowded teeth. Clinical examination revealed that she had a permanent dentition; an Angle's

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Class II subdivision right malocclusion, with an end-on molar relationship on the right; and a Class I molar relation on the left side. Anterior and posterior crowding was observed, with the maxillary right second premolar blocked in and the maxillary canines and mandibular right first premolar blocked out. A lower midline shift of 3 mm to the left was observed, and the mandibular arch was skewed toward the left. Incisor overbite was 6 mm, and overjet was 4 mm [Figure 1].

Model analysis revealed an arch-length discrepancy of 12 mm in the maxillary arch and 10 mm in the mandibular arch. Orthopantomagram revealed an impacted mandibular left second premolar between the roots of the left first premolar and first molar. Cephalometric analysis indicated a retrognathic mandible with compensated lower dentition as indicated by the proclined mandibular incisors [Figure 1 and Table 1].

Treatment objectives were to: (1) alleviate the upper and lower crowding, (2) achieve coincidence of midlines, (3) obtain a normal overjet and overbite, and (4) establish a Class I molar and canine relationship.

In order to address the chief complaints of the patient, and to achieve coincidence of dental midlines, a treatment plan was designed involving extraction of the four first premolars. This would help achieve a symmetrical buccal occlusion, coincidence of maxillary and mandibular dental midlines, optimum overjet, and adequate retraction of the flared lower incisors.

Following therapeutic extraction of all the four first premolars, preadjusted edge-wise appliances (MBT™ prescription, 0.022" × 0.028" slot) were placed in the maxillary and mandibular arches. Initial alignment and leveling was achieved with

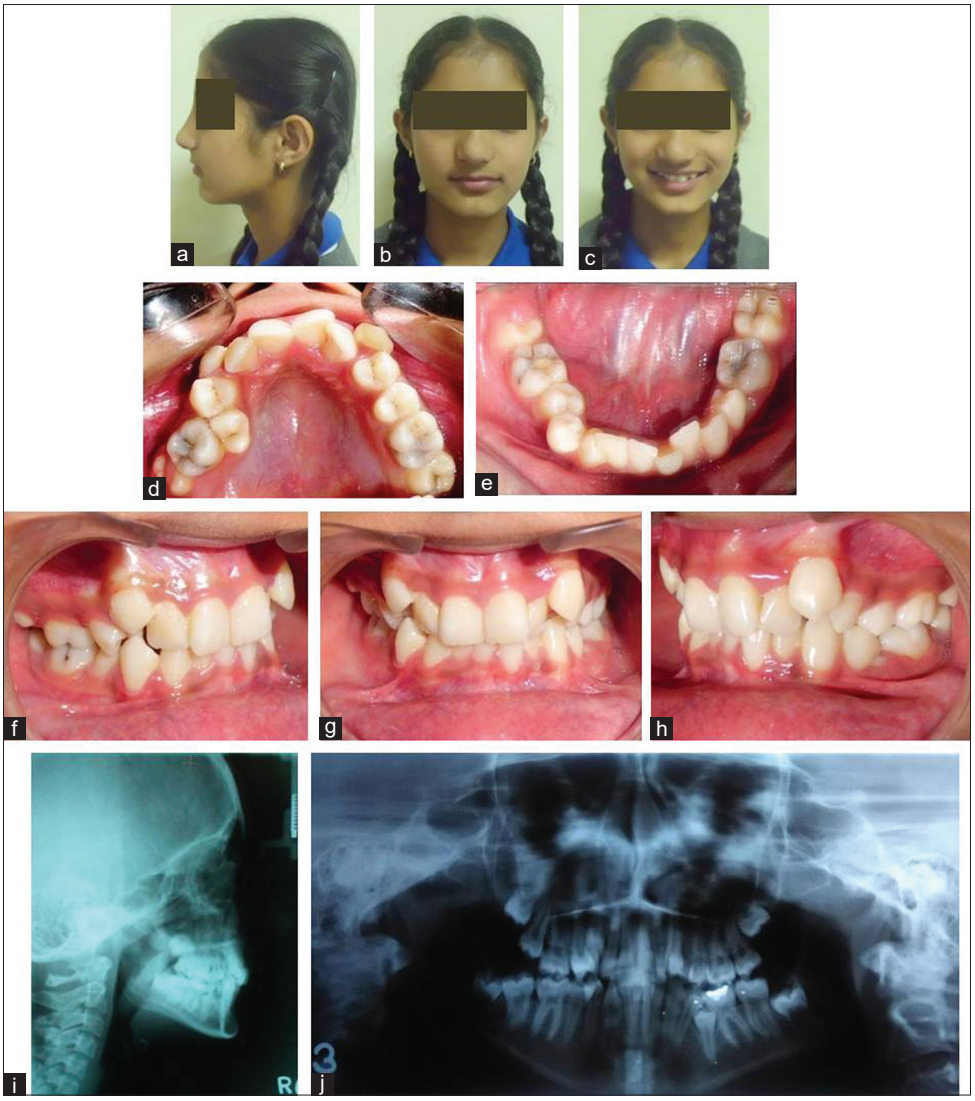

Figure 1: Initial intraoral and extraoral photographs and radiographs: initial, extraoral profile image (a); final, extraoral frontal rest image (b); initial, extraoral frontal smile image (c); initial, intraoral upper occlusal image (d); initial, intraoral lower occlusal image (e); initial, intraoral left lateral image (f); initial, intraoral frontal image (g); initial, intraoral right lateral image (h); lateral cephalogram radiograph image (i); panoramic radiograph image (j)

Table 1: Cephalometric evaluation

Parameters	Pretreatment	Posttreatment
Sagittal		
SNA (°)	73	72
SNB (°)	70	70
SND (°)	68	68
ANB (°)	3	2
Vertical		
SN-GoGn (°)	28	30
FMA (°)	28	30
Dental		
Upper incisor to NA angular	14	21
Upper incisor to NA linear	2	5
Lower incisor to NB angular	18	25
Lower incisor to NB linear	2	5
Incisor-mandibular plane angle	93	90
Interincisal angle	140	128

continuous wires, using improved superelastic 0.016" NiTi followed by 0.020" × 0.020" stainless steel (SS) wire. Postalignment, mandibular midline deviation became even more evident. Maxillary space closure was initiated using continuous 0.018" × 0.025" SS archwire.

After retraction of the mandibular right canine to achieve a Class I canine relation, a segmental biomechanical system was designed to correct the mandibular midline, wherein a 0.018" × 0.025" SS archwire was split into three segments. The right posterior segment spanned from the first molar to the canine, and the left buccal segment included the first molar and second premolar. An anterior segment extending from the right lateral incisor to the left canine consisted of a passive open vertical helical loop extending apically to approximate the center of resistance of the consolidated anterior segment to provide a contact point for the force [Figure 2]. A 0.017" × 0.025" titanium–molybdenum alloy (TMA) cantilever spring extending from the auxiliary tube of the right first molar was bent buccally and tied to the loop with an elastomeric chain. The cantilever was activated to achieve an efficient midline correction through pure translation of the anterior segment[1] [Figure 2]. The lower midline was corrected within 12 weeks without any reactivation of the cantilever or tipping of the lower anteriors. Maxillary arch space consolidation was complete within 13 weeks, with no apparent anchorage loss or bite deepening [Figure 3].

Following the correction of the mandibular midline, protraction of the mandibular molars was carried out on a 0.018" × 0.025" SS wire, and the space gained on the left side was used for relieving minor crowding. Based on the requirements of the teeth, first- and third-order bends were positioned in the maxillary and mandibular continuous 0.018" × 0.025" SS archwires to finalize the tooth positions [Figure 3]. A 0.019" × 0.025" TMA wire with tie-back was used during the finishing stage for improving torque in the maxillary incisor region. After 16 months, the treatment was completed, and all the set treatment objectives were achieved [Figure 4]. Following the end of active appliance phase of treatment, vacuum-formed retainers were used in the upper arch for retention as they were discrete and were well accepted by the patient from an esthetic and comfort perspective, however long-term retention was planned in the lower arch with fixed (bonded) retainers. Verbal informed consent was obtained from the parents of the patient who participated in this study.

DISCUSSION

The undeniable contribution of coordinated facial, maxillary, and mandibular midlines to a successful orthodontic outcome and harmonious facial balance is well documented in literature. With reference to the prevalence of orthodontic asymmetries, mandibular midline deviation from the facial midline has been reported to be the most frequently observed asymmetric trait, accompanied by a lack of coincidence of dental midline.[6] Misdiagnosis and poorly planned treatment mechanics tend to compound the challenging orthodontic management of asymmetric malocclusion.[7]

In the present case, following a thorough clinical examination, it was observed that the patient presented with a morphological lower midline deviation. The presence of a completely retained second premolar on the left side was ascribed as the major etiologic factor contributing to the dental asymmetry.

Treatment of Class II subdivision malocclusion by utilizing unilateral Class II elastics in conjunction with continuous archwires usually entails undesirable side effects such as steepening of the occlusal plane on the side of the correction, skewing of the arches, and flaring of mandibular incisors, thus leading to the development of an asymmetric overjet.[7] The use of segmented arch technique in such situations offers the advantages of a controlled and statically determinate force system without undesirable side effects, as observed in our patient.

Extraction of a combination of teeth for the management of dental asymmetry is a viable modality for simplifying inter-arch and intra-arch mechanics.[8] Adjunctive use of cantilever springs is considered appropriate to enable delivery of qualitatively and quantitatively precise forces at the desired point of force application and offer the

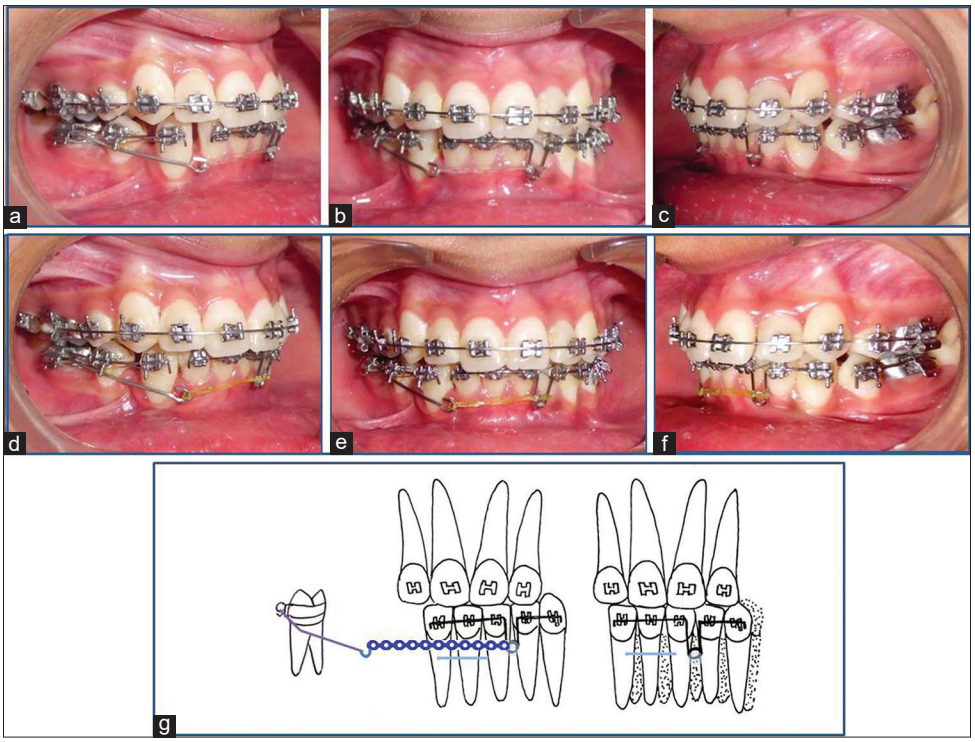

Figure 2: In-progress intraoral photographs and illustration: intraoral right lateral image depicting the cantilever, which is inserted into the auxiliary tube of the molar (a); intraoral frontal image depicting the cantilever tied to the helix of the loop by an elastomeric chain and force is directed at the center of resistance of the anterior segment (b); intraoral left lateral image (c); intraoral photographs depicting midline correction by cantilever appliance activation (d-f); diagrammatic representation of a cantilever spring activation to correct the mandibular midline by translation (g)

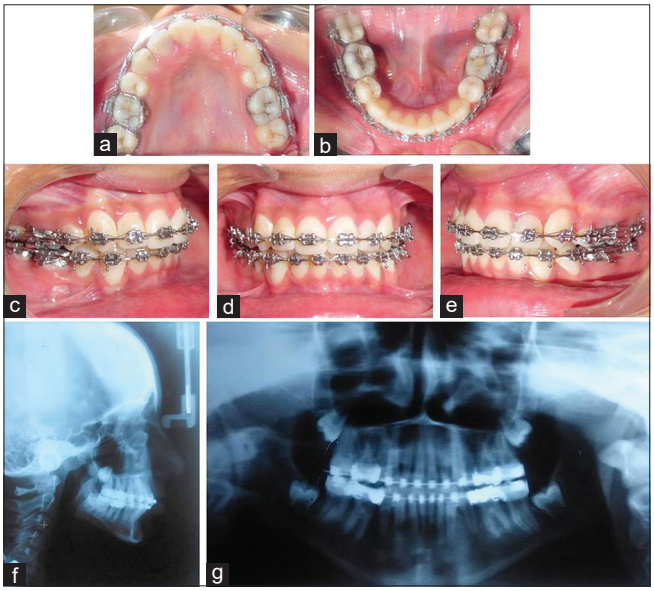

Figure 3: End-stage intraoral photographs and radiographs: intraoral upper occlusal image (a); intraoral lower occlusal image (b); intraoral right lateral image (c); intraoral frontal image (d); intraoral left lateral image (e); cephalogram radiograph image (f); panoramic radiograph image (g)

advantage of ensuring predictable responses on activation, thereby minimizing undesirable side effects.[9] In the present study, TMA wire was chosen for spring fabrication because of its favorable characteristics such as high strength and springiness, low stiffness, excellent formability, and efficient working range.[10] Incorporation of a helix in the open vertical loop helped deliver the spring force closer to the center of resistance of the anterior segment at the same time, ensuring secure engagement of the elastomeric chain without slippage. Thus, the pulling force from the cantilever aided by the elastomeric chain helped correct the midline by translation.

The reasonably acceptable midline correction achieved within 12 weeks shows that individualized treatment planning, setting reasonable objectives, and executing treatment using biomechanically predictable and efficient mechanics, all combine in securing optimal treatment outcome in a relatively short time. Favorable results can be attributed to the early correction of malocclusion and achieving root parallelism, thus ensuring periodontal and dental stability.[11] However, long-term evaluation of the stability of results that are obtained at the end of the treatment is required.

CONCLUSION

The favorable results reported herein illustrate that a well-designed biomechanical system involving the use of segmented arch technique in conjunction with a cantilever offers a simple, yet viable treatment option for midline correction by translation in a relatively short time.

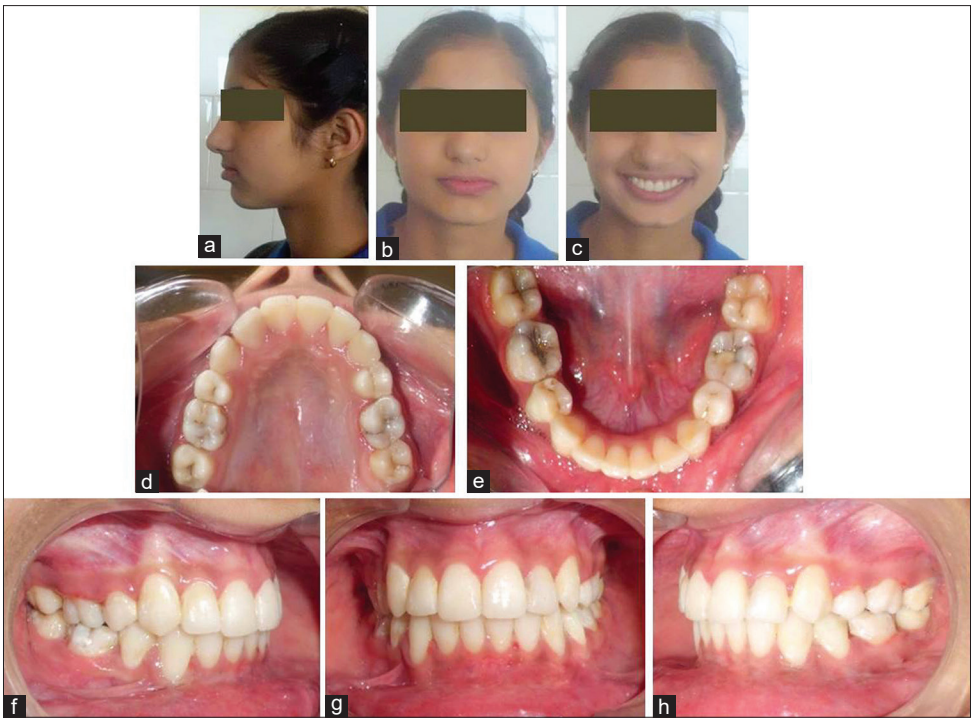

Figure 4: Final intraoral and extraoral photographs: final, extraoral profile image (a); final, extraoral frontal rest image (b); final, extraoral frontal smile image (c); final, intraoral upper occlusal image (d); final, intraoral lower occlusal image (e); final, intraoral right lateral image (f); final, intraoral frontal image (g); final, intraoral left lateral image (h)

Informed consent

Verbal informed consent was obtained from the parents of the patient who participated in this study.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Main Points

1. From a biomechanical perspective, midline asymmetries are a complex therapeutic challenge
2. Segmental approach is utilized to produce a statically determinate force system, thereby eliminating the side effects associated with the use of continuous mechanics
3. Helix in the passive open vertical loop enables a secure point contact of force application near the center of resistance of the anterior segment
4. A simple activated 0.017" × 0.025" TMA cantilever spring aids midline correction by translation.

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