Managing a Pirouetted Central Incisor with a simple Biomechanical Approach

Malvika Agarwal[1], Mukesh Kumar[2], Ekta Yadav[3], Shelly Saxena[4], Shivangi Kumari[5]

Senior Lecturer[1], Professor[2], Senior Lecturer[3], Senior Lecturer[4], PG student[5]

Department of Orthodontics & Dentofacial Orthopedics, Teerthanker Mahaveer Dental College and Research Centre, Delhi Road, Moradabad (UP)

Abstract-

In 2.1-5.1% of untreated individuals, tooth rotation occurs along its longitudinal axis. This multifactorial model of tooth malpositions and one of the hardest eruption disturbances to cure involves space availability for tooth alignment, tooth eruption order, and tongue and lip functional variables. The lack of space for derotation in non-extraction cases, interference with the opposing arch in occlusion, and difficulty bonding and executing derotation mechanics all aggravate the situation. Rotation can be treated with fixed appliance therapy, a modified removable plate whip spring, a removable plate with a Z-spring, an auxiliary archwire, and other options. Apical displacement makes detachable appliances difficult to repair. A fixed appliance corrects abnormal tooth rotation. Equilibrium-based biomechanical force systems can predict and control tooth motion.

Keywords: Rotation, Cantilever mechanics, Hybrid Segmental Mechanics.

INTRODUCTION

Tooth rotation is characterized as evident mesiolingual or distolingual intra-alveolar movement of the tooth across its longitudinal axis, with a prevalence of 2.1 to5.1% in the untreated population.[1] It can be caused by a variety of factors, including space availability for tooth alignment, tooth eruption order, and functional influences exerted by the tongue and lips, which is consistent with a multifactorial model in the origin of tooth malpositions and is one of the eruption disturbances that is most difficult to correct.[2,3] Managing a severely rotated upper central incisor can be challenging. The lack of space for derotation in non-extraction cases, interference with the opposing arch in occlusion, and the difficulty in bonding and applying mechanics for derotation all

Correspondence Address: Dr. Ekta Yadav, Department of Orthodontics and Dentofacial orthopedics, Teerthanker Mahaveer Dental College and Research Centre, Moradabad, Uttar Pradesh, India.
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contribute to the complexity of the situation. Rotation can be corrected using a variety of techniques, including fixed appliance therapy, modified removable plate whip spring, removable plate with Z-spring, auxiliary archwire, and more[4,5,6,7] However, when there is an apical displacement present, it becomes challenging to correct using a removable appliance. Therefore, a fixed appliance is used to correct severe tooth rotation.[8] With the use of precise biomechanical force systems, it is possible to accurately predict and control the movement of teeth. The efficiency of orthodontic appliances, the reduction of adverse effects, and the potential reduction in treatment time canall be enhanced by an understanding and use of fundamental biomechanics.

The segmented arch method given by Charles Burstone in 1962, frequently makes use of cantilevers.[9]Their design has the ability to effectively address a range of clinical issues, consistently delivering reliable outcomes and by utilizing a combination of cantilevers and the straight-wire technique, the potential for displacement of well-positioned teeth can be minimized.[10] So we should avoid connecting "the good with the bad" severely rotated or impacted teeth with continuous archwire aids to prevent serious side effects.

The cantilever is a versatile tool that is often underestimated in clinical practice. The following case report displays the application of cantilever mechanics in addressing severe rotation of a central incisor in an adult patient.

DIAGNOSIS AND TREATMENT PLAN

A 17 -year- old male presented with the chief complaint of upper front rotated teeth. He had no significant medical or dental history. He had convex profile, posterior facial divergence and in-competent lips with upper lip protrusion. Intraorally, Class I molar relationship and Class I canine relationship were present bilaterally with overjet of 3 mm and overbite of 2 mm , spacing of 4 mm in upper arch and crowding of3mm in lower arch(Fig. 1).

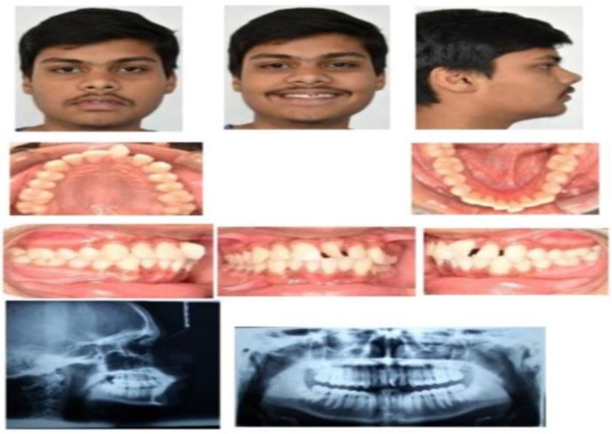

Figure1. 17-year-old male patient with Class I molar relationship, severely rotated upper left central incisor and incompetent lips.

The treatment plan was to extract the upper first premolars bilaterally, but the patient refused thus a non- extraction technique was chosen.

CEPHLOMETRIC TABLE

Sl. no	MEASUREMENTS	RANGE	ACTUAL	
			PRE-TREAT MENT	POST-TREAT MENT
Skeletal				
1	SNA	82°	83°	79.5°
2	SNB	80°	81°	78°
3	ANB	2°	2°	2 °
4	N perpendicular to point A (N ⊥ Pt A)	0-1 mm	2 mm	2 mm
5	N perpendicular to Pogonion (N ⊥ Pog)	-4 to 0 mm	-3 mm	-4 mm
6	Mandibular plane angle (SN-Go-Me)	32°	30°	30°
7	Angle of inclination (Pal plane to Pn ⊥)	85°	87°	87°
8	Y-axis {S-N to S-Gn (outer angle)}	66°	66°	66°
9	Facial axis angle {B-Na to Ptm-Gn (Inner angle)}	90°	91.5°	91.5°
10	Bjork sum (sum of posterior angle)	394° ± 6°	391°	391°
Dental				
11	U I to N-A(mm)	4mm	6 mm	4 mm
12	U I to N-A(angle)	22°	30°	24°
13	L I to N-B (mm)	4mm	3 mm	4 mm

TREATMENT PROGRESS

This case was treated using Hybrid Segmental Mechanics with the non-extraction approach.

Self ligating brackets were used because these brackets are critical for obtaining an adequate torque control.

Except for the severely rotated upper left central incisor, the upper arch was bonded with pre- adjusted edgewise appliance, MBT prescription (.022" x .028" slot, 3M Unitek). A 0.016 Niti wire segment was split and inserted from the right central incisor to the second molar and from the left lateral incisor to the second molar (Fig.2).

Leveling and alignment started with0.016" nickel titanium archwire (NiTi) (3M Unitek nitinol super elastic, USA), and progressed upto .016" x .022" nickel titanium archwire (3M Unitek nitinol super elastic, USA) Both the segments were consolidated. After 3 months of initial levelling and alignment of both the segments, the upper left central incisor was bonded and a single-force cantilever arm made of 0.017× 0.025″ TMA alloy wire along with a sleeve in order to avoid laceration and discomfort to the patient was inserted into the bracket of the central incisors for the derotation of the rotated central incisor (Fig. 3). After 6 months, the central incisor was derotated and a 0.016 Nitiwire was inserted in the upper arch.

After 3 months lower bonding was done and a 0.019”×0.025” ” stainless steel wire was inserted in the upper arch along with a continuous e chain from molar to molar was inserted (Fig 4). After levelling and alignment of upper arch, to close the residual spaces Intrusion arch was used to simultaneously intrude and close spaces in upper arch. (Fig. 5).

Debonding was done after 15 months of overall treatment and fixed upper and lower lingual retainers were bonded at the end of treatment (Fig. 6)

Figure 2. Patient at initial leveling and alignment with 0.016" Niti split wire in upper arch.

Figure 3. A single-force cantilever arm made of 0.017×0.025″TMA alloy wire engaged in the bracket of the upper left central incisor with .016" × .022" stainless steel base arch wire.

Figure 4. A continuous E-chain from right first molar to left first molar was applied in upper arch.

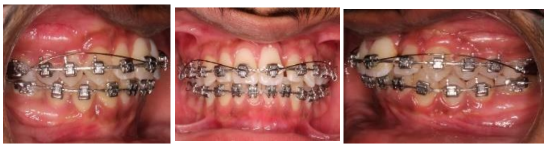

Figure 5. Intrusion Arch made of 0.017×0.025 inch TMA wire was tied between upper centrals for simultaneous intrusion and residual space closure.

Debonding was done after 15 months of overall treatment and fixed upper and lower lingual retainers were bonded at the end of treatment (Fig. 6).

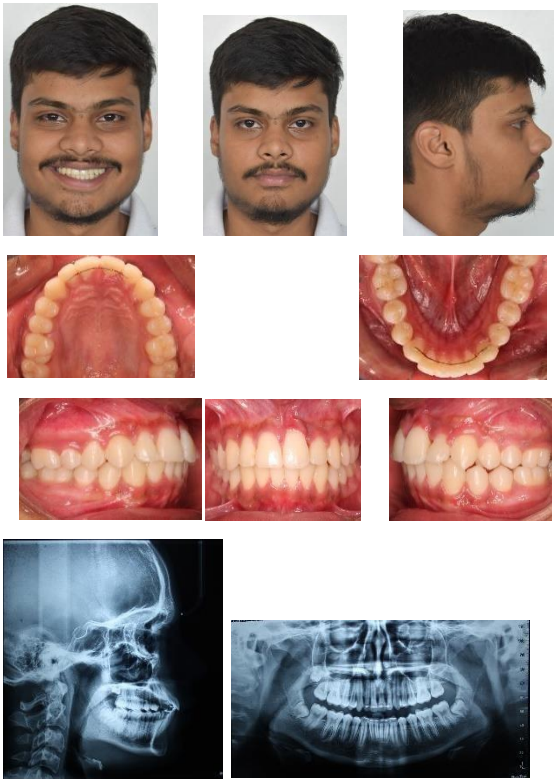

Figure 6. Posttreatment intra and extraoral records after 20 months of treatment.

DISCUSSION

When dealing with such complex orthodontic cases, it's important to employ orthodontic mechanics that can precisely control tooth movement in three dimensions, minimizing any adverse effects.[6] The literature has suggested a number of clinical treatment approaches, such as fixed and removable appliances, to address rotated teeth.[7] Originally, Angle's attached soldered eyelets to the band edges so that rotations could be adjusted or their tendency could be controlled with a separate ligament tie.[8] In fixed appliance, rotating springs were commonly used in the Begg and Tip-Edge techniques, and most preadjusted and standard edgewise brackets do not have the vertical slots needed for such springs,and auxiliary wire was used with such brackets for rotation correction.[9]Using removable appliances in correction of rotated tooth act on one point contact resulting in tipping movements which is less effective for the derotation of tooth than fixed appliance.[6] For rotation correction, pure couple is required, but couple mechanics provides pure couple and but also have some translatory vector involved in them and hence couple force was not used in our case as we needed to correct the tooth rotation on its own axis, and even as light translatory movement was undesirable during rotation correction and hence cantilever mechanics was chosen.[10]

The use of cantilevers in this case provided excellent control over the arch-forms and resulted in a shorter treatment duration, which is beneficial from a clinical perspective. Therefore, it could be seen as an effective method for managing cases that involve single or multiplerotations.[11]A cantilever spring is a very simple and statically determined design. A single force is generated on the mesial end of the one-point contact. On the distal end, there is a reactive force in the opposite direction. These two forces generate a couple that has to be countered by a reactive moment for the sake of equilibrium. The use of a two-tooth system sake of equilibrium. The use of a two-tooth system with a one-couple can enhance the predictability of tooth movement, minimize the need for appliance reactivation, and reduce the occurrence of potential intra-arch complications.[13]This biomechanical system promotes the derotation of tooth on its own long axis (pure rotation). Result obtained was more stable and reduce the total duration of treatment as compared to previously used methods because of less round tripping.

CONCLUSION

With the correct force system and biomechanical understanding, cantilevers generate a predictable force system tosolve the variability of orthodontic problems. With their simple and easily tailored design, these springs can be called an orthodontic multi-tool. The application of biomechanical force systems to move teeth according to a prescribed plan can be easily discerned clinically, thanks to the use of relatively simple designs.

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