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Case Report

Orthodontic Management of a Severely Rotated Central Incisor: A Case Report

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ABSTRACT

Background: *Crowding, rotation and impaction of teeth are some of the complications of supernumeraries. This article aims to discuss the orthodontic treatment of a severely rotated upper left central incisor (UL1) secondary to an erupted mesiodens. An 18-year old Malay male presented with Class I malocclusion with severely crowded upper arch, presence of erupted mesiodens, severely rotated upper left central incisor, displaced upper left lateral incisor and upper left canine and centreline discrepancy.* **Methods:** *He had a combination of segmented arch and couple force mechanics to correct severely rotated central incisors. Following anchorage reinforcement, the upper mesiodens and the upper right first premolar was extracted. Subsequently, treatment was continued with conventional straight wire mechanics.* **Results:** *The severely rotated upper left central incisor was successfully corrected, and the upper arch crowding was resolved. The fixed appliances were debonded and he was provided with upper dual retention. He had gingival recession Type 1 at UL2 due to the bony defect.* **Conclusion:** *Severe crowding can be managed with segmented arch mechanics without any detrimental effects using low forces and good planning. Further periodontal consultation and management were required for the treatment of UL2.*

Keywords: *Segmented arch mechanics, Couple force mechanics, Supernumerary Teeth, Rotated Teeth*

INTRODUCTION

Supernumerary teeth can be defined as an excess in the number of teeth when compared with the normal series of dentition. Few studies reported a lower prevalence of supernumerary in the deciduous dentition than in permanent dentition which ranges from 0.1% to 3.8% (Rajab & Hamdan, 2002). It can occur as single, multiple, unilateral or bilateral, involving maxilla or mandible (Shah et al., 2008). In addition, this pathology is reported to be more common in males than in females with a proportion of 2:1 (Yusof, 1990; Rajab & Hamdan, 2002; Yassin & Hamori, 2009).

Shah et al. (2008) reported that there are four types of supernumerary teeth based on the form and position of teeth. Conical supernumerary, when occurred in the midline, is known as mesiodens. It is the most commonly

found supernumerary (Primosch, 1981; Rajab & Hamdan, 2002). Although only 13-34% of supernumeraries erupt into the oral cavity, it can give rise to complications such as rotation or displacement of the adjacent teeth. Yassin & Hamori (2009) reported that the most common complication of supernumeraries was delayed eruption of the permanent teeth (23.1%). Severely rotated teeth can be challenging to treat with conventional technique as it may result in excessive deflection of archwire beyond the optimum activation and may require additional anchorage reinforcement.

This article discusses the orthodontic mechanics used to correct the severely rotated upper left central incisor and the orthodontic treatment of his malocclusion.

CASE REPORT

MM was an 18-year-old, fit and healthy Malay male who attended the Postgraduate Orthodontic Clinic, Faculty of Dentistry Universiti Teknologi MARA (UiTM), with a chief complaint of crooked teeth. He presented with a Class I incisor relationship on Class II skeletal base and average vertical proportions, which was complicated with the following features:

1. Presence of a supernumerary (mesiodens) between the upper right central incisor (UR1) and the upper left central incisor (UL1)

2. More than 90˚rotation of the labially positioned UL1

3. Moderate crowding of 6mm in the upper arch but the lower arch was fairly well aligned

4. The upper left canine (UL3) was labially positioned while the upper left lateral incisor (UL2) was palatally positioned

5. Upper centreline had shifted to the left by 5mm

6. Class II molar relationship on the right and Class I molar relationship on the left

7. Bolton discrepancy (anterior ratio was 82.1%): upper incisors required build up to eliminate discrepancy, if necessary.

Pre-treatment records were taken prior to the start of the orthodontic treatment, which included extra-oral photographs, intra-oral photographs, dental panoramic tomograph (DPT) and lateral cephalometric (LC) radiograph (Figure 1-4). MM presented with a convex profile and Class 2 skeletal pattern. The severely rotated UL1 and the mesiodens were prominent upon smiling. Intraoral examination revealed that he had good oral hygiene and excellent gingival health despite the severely crowded upper arch. Generally, he was very eager and motivated to commence orthodontic treatment. The dental panoramic tomography (Figure 3) showed the presence of all permanent teeth except the lower third molars. The mesiodens was located between the UR1 and UL1. The lateral cephalometric tomograph (Figure 4) and the cephalometric values (Table 1) confirmed a mild Class 2 skeletal pattern and average vertical proportions.

Figure 1: Pre-treatment extra-oral photographs

Figure 2: Pre-treatment intra-oral photographs

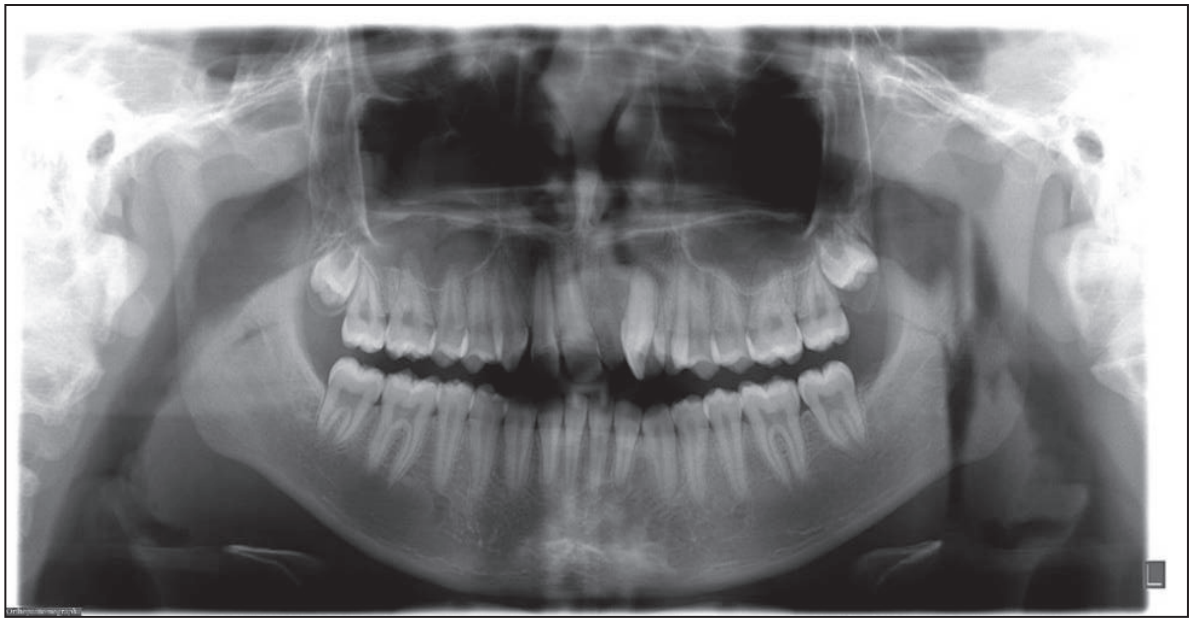

Figure 3: Pre-treatment dental panoramic tomograph.

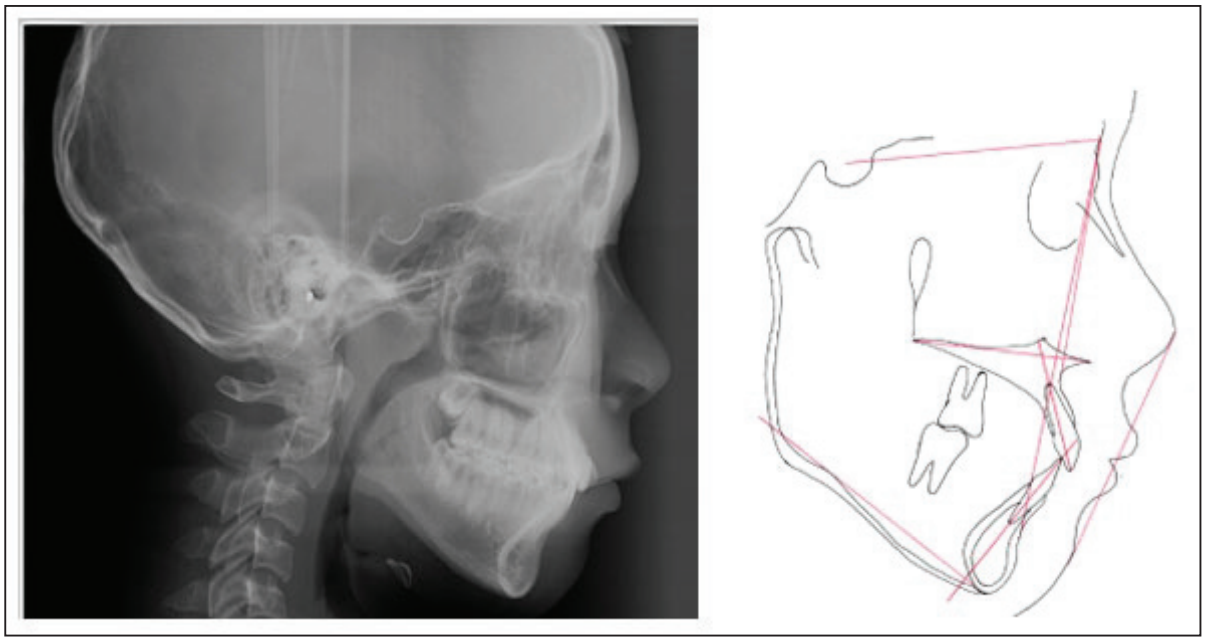

Figure 4: Pre-treatment lateral cephalometric radiograph and hand tracing.

Table 1: Pre-treatment LC values

Variables	Patient values	Caucasian Norm
SNA	77˚	81˚±3˚
SNB	74˚	78˚±3˚
ANB	3˚(EC: 5˚)	3˚±2˚
MMPA	32˚	26˚±3˚
SNMxP	11˚	8˚±3˚
%LFH	53%	Mean 55%
UIA	110˚	109˚±6˚
LIA	92˚	93˚±6˚
IIA	136˚	135˚±10˚

*Red denotes values out of the standard deviation
*EC: Eastman correction

Aims and Objectives of Treatment

1. Maintain optimum dental health and oral hygiene throughout treatment
2. Accept the underlying Class 2 skeletal pattern
3. Relieve the crowding and align the severely rotated central incisor
4. Level the upper and lower arches
5. Normalise the overbite and overjet
6. Correct the centreline discrepancy
7. Maintain the Class I molar relationship on the left and Class II molar relationship on the right
8. Achieve Class I canine relationship bilaterally
9. Finishing and detailing the occlusion
10. Retain the corrected occlusion
11. Monitor eruption of the upper third molars

Treatment Plan

1. Maintenance of his oral hygiene through oral health education and instructions
2. Transpalatal arch (TPA) for anchorage reinforcement
3. Extraction of the mesiodens and the upper right first premolar (UR4)
4. Upper and lower pre-adjusted edgewise fixed appliances on a 0.022”x0.028” bracket slot with MBT prescription
5. Retention

SEQUENCE OF TREATMENT

Following the cementation of the TPA, extractions of the mesiodens and the UR4 were carried out. Then, the upper arch was bonded segmentally (Figure 5) on the right side of maxilla from the upper right second premolar (UR5) to UR1 (Burstone, 1966). Upper 0.014" Nickel-Titanium (NiTi) archwire was placed segmentally.

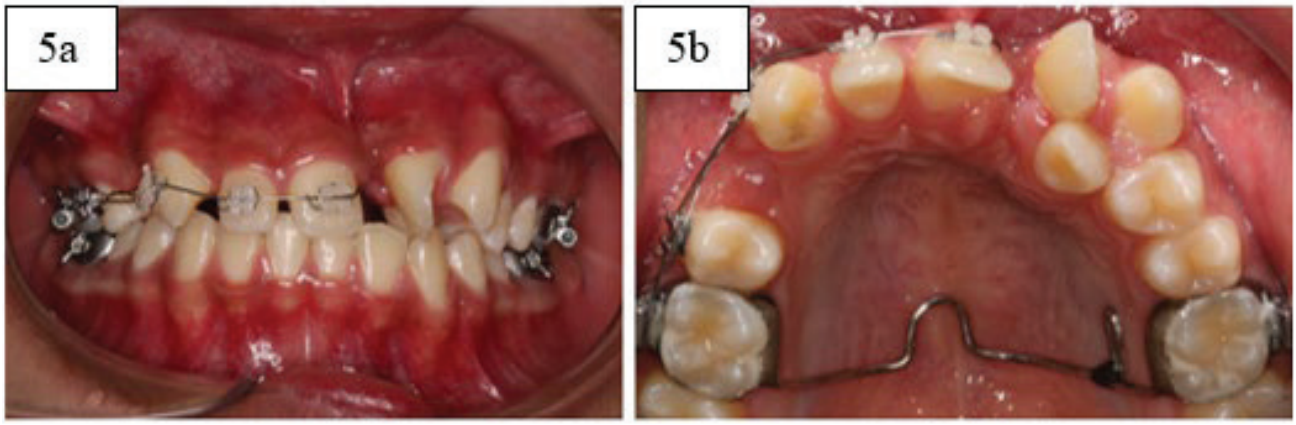

Figure 5: Segmented arch mechanics for initial alignment of upper teeth (5a: Frontal view, 5b: Occlusal view)

After 2 months, the upper archwire was progressed to 0.018" NiTi, followed by 0.018" × 0.025" NiTi and 0.018" × 0.025" stainless steel (SS). Space creation for the alignment of UL1 and centreline correction was performed by distalizing the UR3 into the extraction space using elastomeric chain.

When the space for alignment of UL1 was obtained, the left quadrant was bonded from UL3 to UL6, and 0.012" NiTi archwire was placed segmentally, whilst maintaining the 0.018" × 0.025" SS archwire on the right quadrant. Two buttons were bonded on the mesial and distal surfaces of UL1 prior to the introduction of the couple force technique [7]. The 0.018" × 0.025" SS archwire on the right was bent incisally at the mesial end to act as a point of attachment. Two sets of elastomeric chains were used. One of them was attached from the mesial end of 0.018" × 0.025" SS (bent end) to the bonded button on the mesial surface of UL1 and the other elastomeric chain from the bonded button at the distal surface of UL1 to the molar band hook of upper left first permanent molar (UL6) (Figure 6). This mechanic is known as the couple force technique, which was created by two forces that have equal magnitude but exerted in opposite direction to one another with parallel forces (Upadhyay and Nanda, 2015). The optimum force applied, which ranged between 50 and 100 grams, was confirmed with a strain gauge (Correx Strain Gauge).

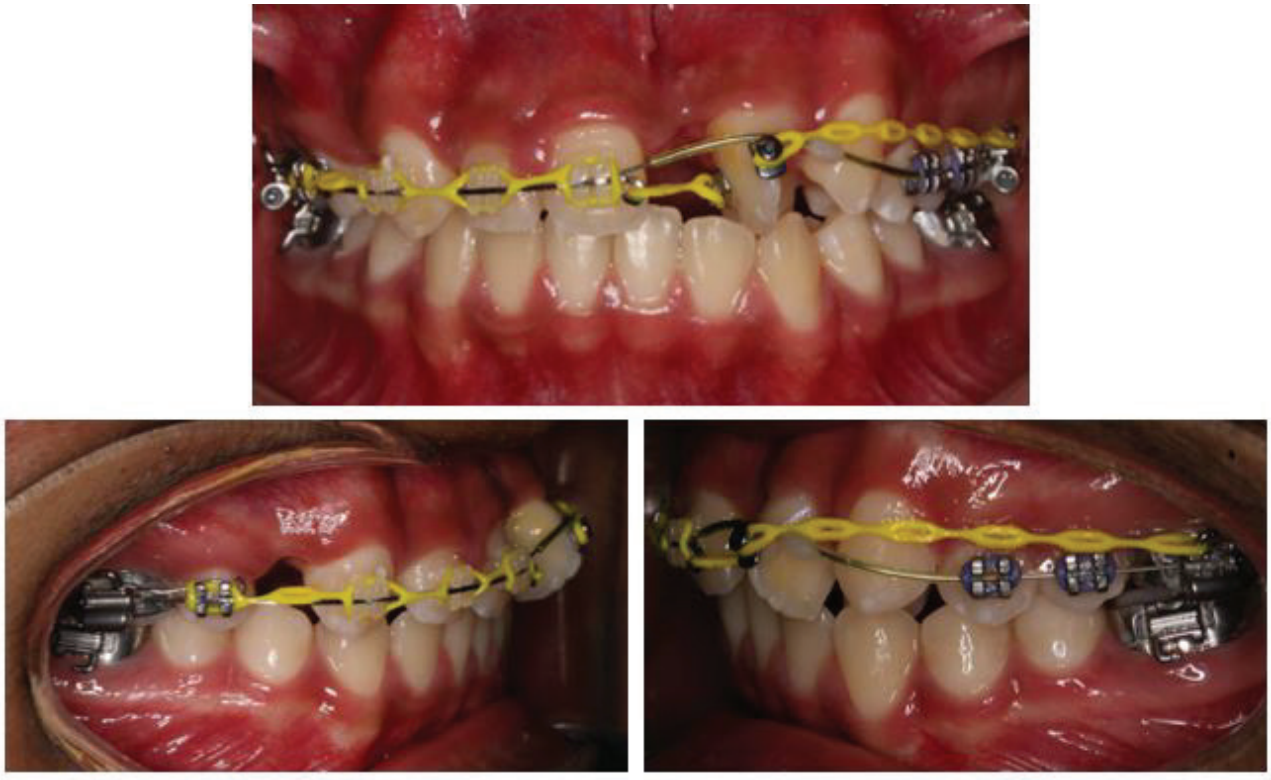

Figure 6: Couple force mechanic

The position of the buttons at the mesial and distal aspect of UL1 were gradually repositioned to allow full correction of the rotation until bonding of the bracket was possible (Figure 7). He was reviewed monthly, and after 7 months, the UL1 was successfully aligned. Following the correction of the UL1, a continuous upper archwire was placed, and the wire sequences were 0.014" NiTi, 0.018" NiTi, 0.018" × 0.025" NiTi, 0.018" SS (centreline correction) and 0.018" × 0.025" SS. Figure 8 shows upper arch on 0.014" continuous NiTi archwire.

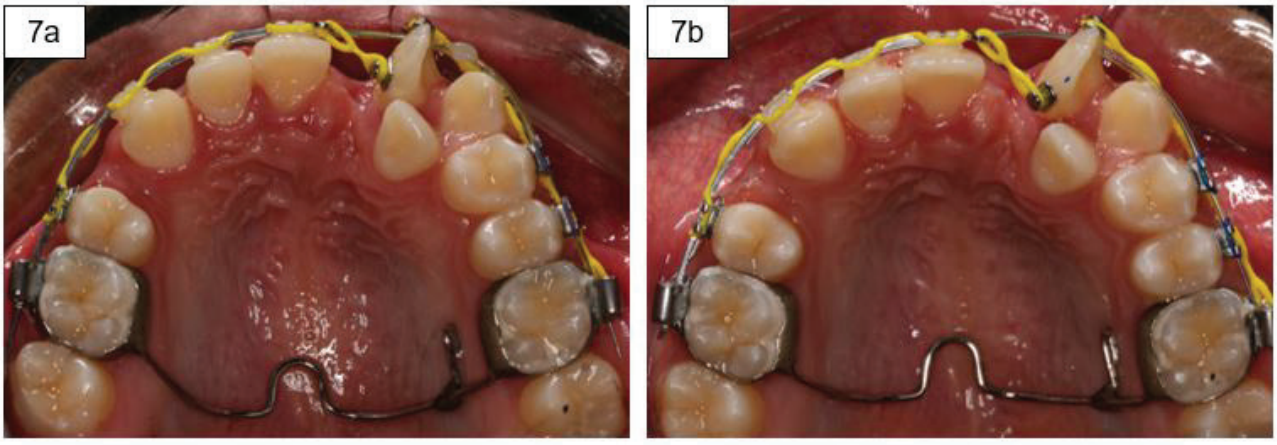

Figure 7: Adjustment of the button on mesial UL1
(7a: button was labially positioned, 7b: button was repositioned mesially)

Figure 8: Continuous upper archwire

Figure 9 shows an upper continuous 0.018" SS archwire placed with the elastomeric chain from UR3 to UR6 to allow retraction of the upper right canine (UR3) for the midline correction. At this stage, the upper centreline was further corrected and the space for alignment of UL2 was obtained. Once there was adequate space for the UL2, a 0.012" NiTi archwire was used to piggyback UL2 on the 0.018" SS main archwire. The bracket on UL2 was inverted to facilitate a 20˚conversion of root torque on the UL2 (-10˚).

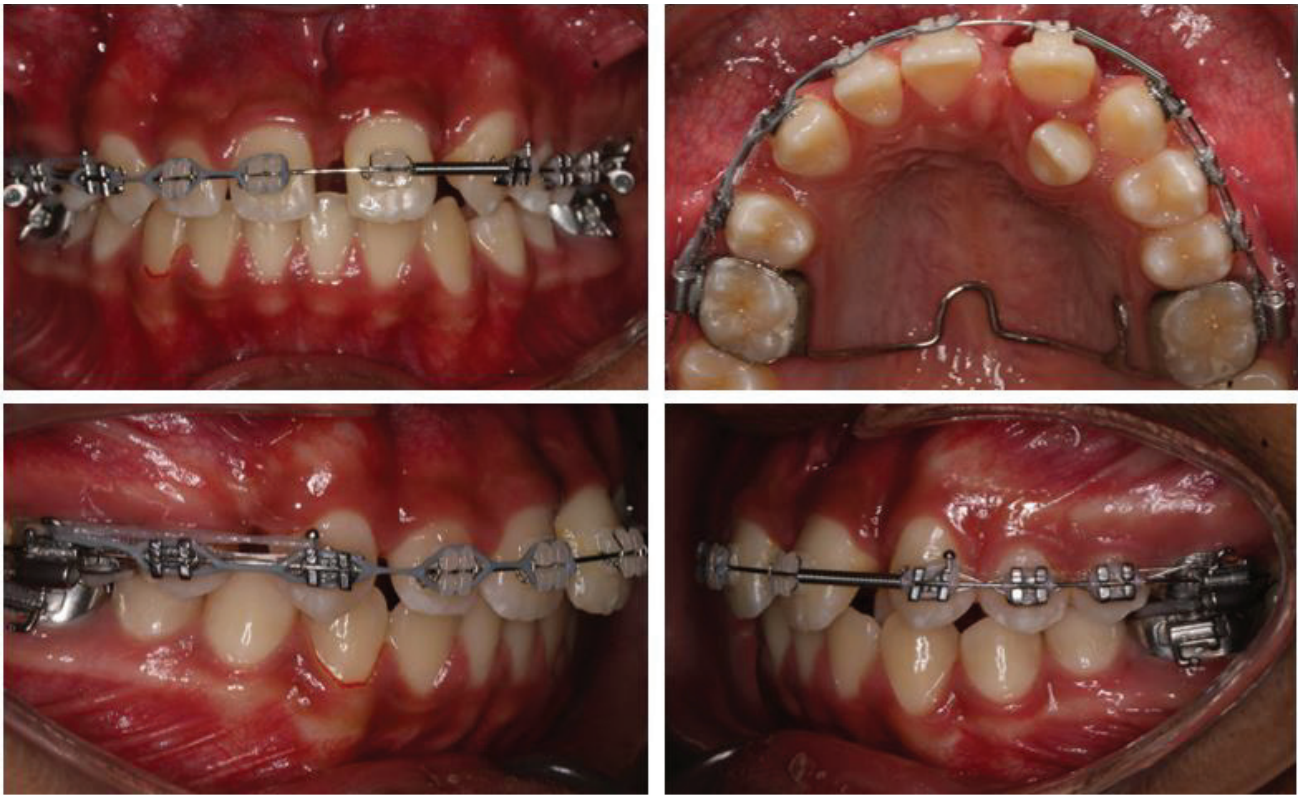

Figure 9: Placement of elastomeric chain on right quadrant

Once the upper arch was aligned, the lower teeth were bonded, and the archwire sequence progressed from 0.014" NiTi to 0.018" NiTi and followed by 0.018" × 0.025" NiTi and 0.019" × 0.025" SS (Figure 10a). The prominent buccal root torque of the upper canines were reduced by adding palatal root torque (Figure 10b).

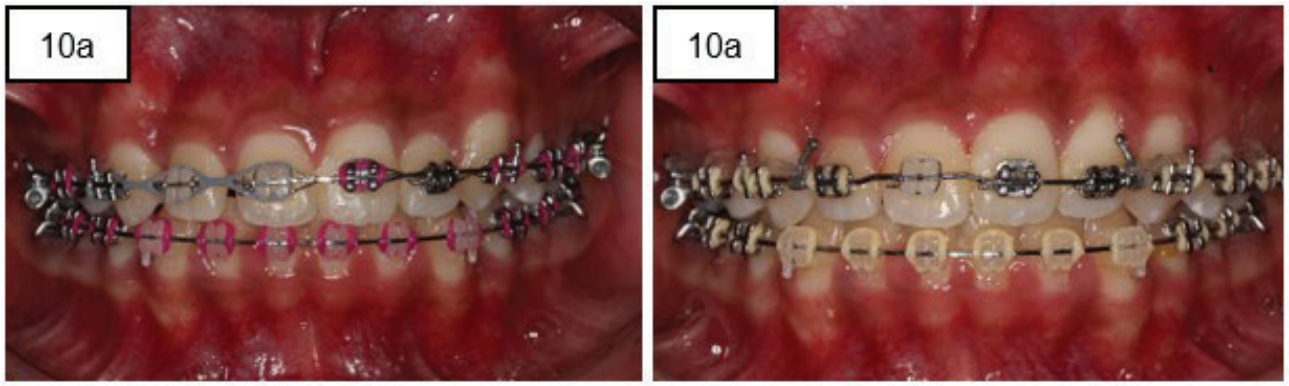

Figure 10: Finishing stage (10a: Lower archwire (0.019" × 0.025" SS) and prominent buccal torque upper canines, 10b: The prominent upper canines corrected with the introduction of palatal root torque

TREATMENT RESULT

Segmented arch and couple force mechanics were utilised to successfully correct the position of the UL1 leading to the improvement in aesthetics. Near-end DPT (Figure 11) showed a slight distally angulated UR2 and mesially angulated UL3. Second-order bends were incorporated for the detailing. Figure 12 shows manual superimposition of the pre- and near-end LC radiographs. Overall superimposition revealed no significant changes in the anteroposterior and vertical dimension indicating that the patient did not demonstrate any obvious growth in the anteroposterior or vertical plane. Additionally, the orthodontic mechanics that were applied was able to control the vertical movement of posterior teeth. Apart from that, the soft tissue superimposition also showed minimal changes. Dentally, the upper first molar moved slightly forward to finish in Full unit Class II molar, while the upper incisors were slightly retroclined compared to the initial position. This was beneficial and expected to allow the camouflage of his skeletal pattern. No significant changes can be seen on the lower arch.

Figure 11: Near-end DPT

Figure 12: Manual superimposition

Figures 13-14 show the post-treatment extra oral and intra oral photographs. Generally, good occlusion and interdigitation have been achieved. However, it was anticipated that the canine relationship in Class II ¼ unit especially on the left due to the Bolton discrepancy. To correct the discrepancy, further treatment such as extraction, distalization, and additional second order bend at upper canines may have been necessary, but it may associate with the long-term dental maintenance. He was happy with outcome and refused on further orthodontic treatment. There was a gingival recession noted at UL2 (3mm) due to bony defect without deep periodontal pocket. He was referred to the Periodontology department and was diagnosed with Gingival Recession Type 1 (Cairo et al., 2011), which require coronally advanced flap and connective tissue graft. We will discuss with MM if he is keen for the periodontal surgery upon review.

Figure 13: Post-treatment extra-oral photographs

Figure 14: Post-treatment intra-oral photographs

DISCUSSION

Couple force mechanics is a simple and useful method to correct the rotation of permanent teeth utilizing light forces. This force should be directed in opposite directions facilitating the derotation and alignment of teeth. It can be used in conjunction with other mechanics, such as centreline correction. Upadhyay & Nanda (2015) described couple as a form of moment, and because the forces carry the same magnitude but oppositely directed, the net potential of this particular force system to move the body upon which it acts will be negated; thus, there is only rotation. Therefore, this type of orthodontic mechanics was suitable and favourable for this case.

Patient's Compliance and Cooperation

Patient cooperation is an essential factor in the success of orthodontic treatment. According to Albino (2000), the conceptual model of factors influencing orthodontic treatment decision consists of patients' perception of dento-facial attractiveness and patients' perceived need for treatment, albeit an orthodontist evaluation of treatment need that shows a need for orthodontic treatment. The positive result of orthodontic treatment requires not only knowledge and technical competence but also a considerable effort by the patient. Earlier studies demonstrated that a lack of cooperation from the patient had a significant effect on the length of orthodontic treatment time, including patient's personal characteristics even though it did not significantly alter the quality of orthodontic treatment. Subsequently, the patient must wear the appliance longer, and this will give rise to multiple complications (Beckwith et al., 1999; Skidmore et al., 2006). MM was very motivated and the continuous correction of the rotated UL1 was obviously appreciated. His cooperation and commitment throughout the treatment led to a successful outcome.

Initial Alignment

In this case, accurate bracket placement facilitated the initial alignment. It was followed by the introduction of a flexible NiTi archwire into the bracket slots. The light force was applied to allow tooth movement in all three planes of space. An ideal archwire should be able to minimise patient discomfort, tissue hyalinization and

root resorption. Previous studies showed that NiTi would provide considerable deflection by delivering a light and relatively constant amount of force. Moreover, it also exhibits an exceptional feature in terms of elasticity and maintaining shape memory which can be seen by a larger spring back capacity compared to a stainless-steel wire (Gurgel et al., 2001; Ferreira et al., 2012). Due to the mentioned properties of NiTi, it was used in the initial alignment of teeth. However, another study reported that except for a higher stiffness of multi-stranded stainless steel archwire, there were no differences in the rate of alignment or pain between multi-stranded stainless steel and NiTi wires (Jian et al., 2013).

Once the right quadrant was aligned, stainless steel wire was then used for retraction of anterior segment to provide space for de-rotation of UL1 and midline correction. It provided enough rigidity to allow an optimum tooth movement.

Segmented Arch Mechanics

The segmented arch mechanic was introduced by Dr Charles Burstone in 1966. It was designed to control tooth movement with a known moment to force ratio and to optimise biologic response through the application of a relatively constant force at an optimal magnitude (Burstone, 1966). This technique was usually implemented in an extraction case for anchorage control. In segmented archwire mechanics, site of force dissipation can be selected, whereby in continuous arch mechanics, reactive forces are dissipated around points of the force application. Thus, it was decided to use segmented mechanics in this case. It is also suggested for other specific case such as canine extrusion and retraction, deep bite correction, molar uprighting and occlusal plane correction (Caldas et al., 2014). After the initial segmented arch mechanics, treatment was continued with straight wires.

The resilient force of elastomeric in tension or compression is typically used to move a tooth or an orthodontic appliance relative to other teeth or orthodontic appliances. In this case, we used elastomeric elongated chain-like modules (powerchain) on a segmented arch mechanic to exert forces for orthodontic tooth movement. We used a strain gauge to measure an optimal amount of force. The light continuous force was proven to give an ideal tooth movement and provided minimal strain on anchorage (Samuels et al., 1993). Furthermore, a higher force (300 grams) would not result in a faster tooth movement or reduction in overall treatment time, yet it will predispose to a higher site of hyalinization (Owman-Moll et al., 1996; Yee et al., 2009). Hence, we decided to introduce an optimal force measured for the derotation of UL1 and throughout the treatment to ensure a successful outcome.

Anchorage Reinforcement

Anchorage control has continuously been an area of concern in orthodontics. It is common to reinforce the anchorage in the upper arch during the fixed appliance treatment. This can be in the form of transpalatal arch (TPA), mini-implant (MI) or headgear. However, a non-compliant (TPA and MI) anchorage control is always preferable over headgear (Alhadlaq et al., 2015). In the presented case, correction of severely rotated teeth and centreline shifts required a localised moderate-high anchorage demand. Although Sharma et al. (2012) reported that MI had shown significant anchorage control over other types of anchorage, the use of TPA when combined with segmented arch results in adequate anchorage control.

As described by Goshgarian in 1972, TPA can provide passive and active orthodontic forces in all three planes. The wire goes across the palatal contour from one molar to the contralateral molar and is soldered to the molar bands. The advantages of the TPA are to reduce anterior molar movement and act as an anchorage reinforcement. Besides that, it also provided arch width stabilisation during orthodontic treatment. It can be modified to incorporate other components such as anterior bite plane, Nance button (introduced by Nance in 1947), hook to facilitate orthodontic treatment and auxiliary springs. In this case, a hook was soldered to the palatal part of the transpalatal arch to provide an attachment of the elastomeric chain to a rigid wire. However, the severely rotated UL1 was derotated successfully using the couple force. However, it was fabricated at the start as the cost to re-fabricate a new TPA if the hook was required would increase the overall cost of the orthodontic treatment. Having that in mind, the hook was incorporated at the initial treatment plan.

Retention

Overall superimposition showed that this patient was not actively growing. Dental superimposition showed minimal dental changes which enhances the stability of the treatment. Stability is a concern with any severely rotated teeth post orthodontic treatment. In this case, it had a high risk of relapse due to over-stretched supra alveolar and transeptal fibres indicating fixed retainer (Littlewood et al., 2017). In agreement, previous studies investigating relapse tendency after orthodontic correction of anterior teeth reported that it was reduced after retained with fixed retainer (Naraghi et al., 2006; O'Rourke et al., 2016). In addition, there are reports of occasional, severe and unwanted tooth movement and relapse caused by failed fixed retainers as a result of bonding or wire fatigue (Shaughnessy et al., 2016; Littlewood et al., 2017). Therefore, we decided to implement dual retention with fixed and removable retainers. The Hawley retainer was chosen over thermoplastic retainer as it was superior in allowing settling of occlusion and better oral hygiene maintenance (Sauget et al., 1997). On top of it, we achieved good overjet, overbite and interdigitation. In terms of retainer regime, MM was advised to wear the retainers full time for the first 6 months and night-time only afterwards. Although previous studies reported no difference in the stability of teeth in a patient wearing full-time or night-time only (Thickett & Power, 2009; Gill et al., 2007), we encourage this patient to wear it full time for the first 6 months to ensure compliance and motivation. He was also informed of the importance of long-term retention to ensure the stability of the orthodontic outcome.

CONCLUSION

Couple force and segmented arch mechanics can successfully be implemented to correct a severely rotated central incisor. The use of light forces and careful monitoring can avoid trauma to the rotated tooth. The proposed technique is a clinically manageable and relatively simple procedure.

DECLARATION

This work was previously presented as a poster presentation at the 9th Dental Student's Scientific Symposium, held on 9th -10th April 2019, in Faculty of Dentistry, Universiti Teknologi MARA, Sungai Buloh, Selangor.

REFERENCES

Albino JEN (2000). Factors influencing adolescent cooperation in orthodontic treatment. *Semin Orthod. 6*(4):214-223.

Alhadlaq A, Alkhadra T, El-Bialy T (2015). Anchorage condition during canine retraction using transpalatal arch with continuous and segmented arch mechanics. *Angle Orthod. 86*(3):380-385.

Beckwith FR, Ackerman RJ Jr, Cobb CM, Tira DE (1999). An evaluation of factors affecting duration of orthodontic treatment. *Am J Orthod Dentofacial Orthop. 115*(4): 439-447.

Burstone CJ (1966). The mechanics of the segmented arch techniques. *Angle Orthod. 36*(2):99-120.

Cairo F, Nieri M, Cincinelli S, Mervelt J, Pagliaro U (2011). The interproximal clinical attachment level to classify gingival recessions and predict root coverage outcomes: an explorative and reliability study. *J Clin Periodontol.* Jul;38(7):661-6.

Caldas SG, Ribeiro AA, Simplicio H, Machado AW (2014). Segmented arch or continuous arch technique? A rational approach. *Dental Press J Orthod. 19*(2):126-141.

Ferreira M, Luersen M, Borges P (2012). Nickel-titanium alloys: A systematic review. D*ental Press J Orthod. 17*:71-82.

Gill D, Naini F, Jones A, Tredwin C (2007). Part-time versus full-time retainer wear following fixed appliance therapy: a randomized prospective controlled trial. *World J Orthod. 8*(3):300-306.

Gurgel JA, Kerr S, Powers JM, LeCrone V (2001). Force-deflection properties of superelastic nickel-titanium archwires. *Am J Orthod Dentofacial Orthop. 120*(4):378-382.

Jian F, Lai W, Furness S, McIntyre G, Millett D, Hickman J, Wang Y (2013). Initial arch wires for tooth alignment during orthodontic treatment with fixed appliances. *Cochrane database of systematic reviews (Online). 4*:CD007859.

Littlewood S, Kandasamy S, Huang G (2017). Retention and relapse in clinical practice. *Aust Dent J. 62*(S1):51-57.

Naraghi S, Andrén A, Kjellberg H, Mohlin B (2006). Relapse tendency after orthodontic correction of upper front teeth retained with a bonded retainer. *Angle Orthod. 76*(4):570-576.

O'Rourke N, Albeedh H, Sharma P, Johal A (2016). Effectiveness of bonded and vacuum-formed retainers: A prospective randomized controlled clinical trial. *Am J Orthod Dentofacial Orthop. 150*(3):406-415.

Owman-Moll P, Kurol J, Lundgren D (1996). Effects of a doubled orthodontic force magnitude on tooth movement and root resorptions. An inter-individual study in adolescents. *Eur J Orthod. 18*(2):141-150.

Primosch RE (1981). Anterior supernumerary teeth--assessment and surgical intervention in children. P*ediatr Dent. 3*(2):204-215.

Rajab LD, Hamdan MAM (2002). Supernumerary teeth: review of the literature and a survey of 152 cases. *Int J Paediatr Dent. 12*(4):244-254.

Samuels RH, Rudge SJ, Mair LH (1993). A comparison of the rate of space closure using a nickel-titanium spring and an elastic module: a clinical study. *Am J Orthod Dentofacial Orthop. 103*(5):464-467.

Sauget E, Covell DA Jr, Boero RP, Lieber WS (1997). Comparison of occlusal contacts with use of Hawley and clear overlay retainers. *Angle Orthod. 67*(3):223-30.

Shah A, Gill DS, Tredwin C, Naini FB (2008). Diagnosis and management of supernumerary teeth. *Dent Update. 35*(8):510-520.

Sharma M, Sharma V, Khanna B (2012). Mini-screw implant or transpalatal arch-mediated anchorage reinforcement during canine retraction: A randomized clinical trial. *J Orthod. 39*(2):102-110.

Shaughnessy TG, Proffit WR, Samara SA (2016). Inadvertent tooth movement with fixed lingual retainers. *Am J Orthod Dentofacial Orthop. 149*(2):277-286.

Skidmore KJ, Brook KJ, Thomson WM, Harding WJ (2006). Factors influencing treatment time in orthodontic patients. *Am J Orthod Dentofacial Orthop. 129*(2):230-238.

Thickett E, Power S (2009). A randomized clinical trial of thermoplastic retainer wear. *Eur J Orthod. 32*(1):1-5.

Upadhyay M, Nanda R (2015). Chapter 4 - Biomechanics in Orthodontics. In R. Nanda (Ed.), *Esthetics and Biomechanics in Orthodontics (Second Edition)* (pp. 74-89). St. Louis: W.B. Saunders.

Yassin OM, Hamori E (2009). Characteristics, clinical features and treatment of supernumerary teeth. *J Clin Pediatr Dent. 33*(3):247-250.

Yee J, Turk T, Elekdag-Turk S, Cheng L, Darendeliler MA (2009). Rate of tooth movement under heavy and light continuous orthodontic forces. *Am J Orthod Dentofacial Orthop. 136*(2):150.e151-159.

Yusof WZ (1990). Non-syndrome multiple supernumerary teeth: literature review. *J Can Dent Assoc. 56*(2):147-149.