

Case Report

Treatment of severe rotations of maxillary central incisors with whip appliance: Report of three cases

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ABSTRACT

The routine treatment for rotated maxillary incisor is a fixed appliance, but in some instance the use of this method is impossible. In addition, in only limited cases of rotation, removable appliance is applicable. In this study, the use of a semi-removable appliance is presented, which has some benefits over the other methods. In this study, the corrections of about 70-90° rotation of the maxillary central incisors in different phases of mixed dentition were performed in three patients using whip appliance. This method was performed using a simple removable appliance such as Hawley appliance and whip spring that forced the couple to derotate the tooth. In all cases, treatment was successfully completed in relative short duration. Whip appliance can be recommended as an effective method to correct rotation of maxillary incisor in mixed dentition with several advantages like rapid correction.

Key Words: Maxillary incisor, tooth rotation, whip appliance

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INTRODUCTION

Tooth rotation is considered subjectively as any evident (at least 20°) mesiolingual or distobuccal intra-alveolar displacement of tooth around its longitudinal axis.^[1] In the untreated population, the prevalence of tooth rotation is 2.1-5.1%.^[2]

The rotation of permanent teeth can be divided into two groups based on etiologic factors:

1. Rotation of permanent teeth due to pre-eruptive disturbances.^[3] Among these factors are the injury of the pre-maxillary region in childhood, that displaced and misaligned the developing tooth bud. In addition, the presence of an adjacent pathology such as cyst, tumor, odontoma, supernumerary tooth (mesiodens) can interfere with eruption of the tooth.^[4] Mesiodens

can cause ectopic eruption, displacement or rotation of a central incisor in 28-63% of cases.^[5]

2. Those caused by post-eruptive disturbances, such as habitual, mechanical, local, or environmental factors.^[3] In a dental arch with crowding, rotations are often present, but in cases of space excess rotations might also occur.^[6] Environmental factors such as space availability for tooth alignment, path of tooth eruption and functional effects produced by tongue and lips, should also be recognized in the etiology of tooth rotations, along with a multi-factorial model in the origin of tooth malpositions.^[7]

The treatment of maxillary anterior permanent teeth with rotation can be performed by several methods:

The routine treatment of rotated teeth is use of fixed appliance.^[8] Also, in some conditions such as slight rotation, correction can be performed with a removable appliance such as an appliance with a labial bow and palatal spring.^[9]

In this study, three patients with relatively severe rotation of the maxillary central incisors treated with a very effective semi-removable appliance, whip appliance, are presented.

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Figure 1a: Before treatment

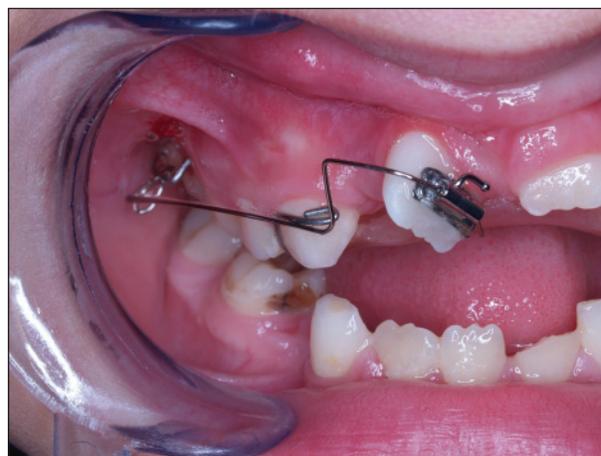


Figure 1b: 2 month after starting treatment



Figure 1c: 4 month after starting treatment



Figure 1d: Retention phase



Figure 1e: 1 year follow-up radiographic view

CASE REPORTS

Case 1

A 7-year-old boy was referred to the Pediatric Dentistry Department of Mashhad University of Medical Sciences

with the chief complaint of severe rotation of one of his maxillary central incisor and a wound in the maxillary anterior labial mucosa caused by the continuous irritation of the incisal edge of rotated tooth. The medical history of the patient revealed no problems. In the extra oral examination, regarding lateral view, patient was mild convex and lip competent and in frontal view he was mesoprosopic. In the intraoral examination, there was Class I molar relationship with about 70° rotation of right maxillary central incisor [Figure 1a]. Skeletal relationship of the patient was Class I and he did not have vertical problem. In the radiographic examination, pathologic problems such as supernumerary teeth or odontoma were not discovered, and revealed that 3/4 root was completed. After taking an alginate impression to fabricate study model, space analysis on study models did not show any space deficiency. The parents rejected any traumatic injury to the upper jaw in the past, but the history of intensive finger sucking habit

was reported. At the first step, because of severe dental plaque accumulation due to inadequate oral hygiene, 1 week time was given to the patient to correct his oral hygiene. During this period, the parents were instructed to cover the incisal edge of rotated central incisor with wax to prevent continuous irritation of labial mucosa and to change it after each meal. In despite of the existence of dental caries in deciduous teeth of patient, the parents did not agree with restoring these teeth. After a week, an alginate impression was taken of the upper jaw in order to construct a removable appliance. This appliance was made of acrylic base plate, circumferential clasps on the maxillary primary canines and Adams clasp on the maxillary permanent first molars. In the later appointment, a mandibular first molar buccal tube (Dentaurum, Germany) was bonded directly on the labial surface of the rotated central incisor with light cured composite resin (Trans Bond XT, 3M Unitek, USA). Whip spring was built with a segment of 0.4 mm stainless steel orthodontic wire (0.0016 inches) (Dentaurum, Germany), in which the distal end of the wire was bended to form vertical loop facing upward and immediately a vertical loop facing downward [Figures 2a-c]. The mesial end of the spring was inserted into the slot of the tube and to prevent damage to the gingival tissue, the outer end of the wire from the buccal tube was bent toward the incisal edge. The hook created in the distal end of the spring was engaged into the bridge portion of the right Adams clasp. The patient was instructed to remove the appliance only for tooth brushing after eating and in the rest of the time to wear the appliance for prevention of damage to gingival and buccal mucosa by the whip spring. After a few days, the patient returned with the complaint of a painful wound caused by whip spring in the mucobuccal fold area. Therefore, in order to deviate the wire from the vestibular mucosa, a vertical bend down and then a horizontal bend to distal was formed. The patient had no problem with the whip spring after this modification.

After 4 weeks, the tooth was derotated very well. [Figure 1b] There was no need to cover the incisal edge and the wound in labial mucosa completely healed. In every follow-up appointment, with a month interval, the whip spring was replaced by a new one. After 4 times replacement of the spring, rotation was almost corrected [Figure 1c]. In order to overcorrect the rotated tooth, another removable appliance with a z-spring that forced the mesial aspect of lingual surface of the tooth was fabricated. At the end of

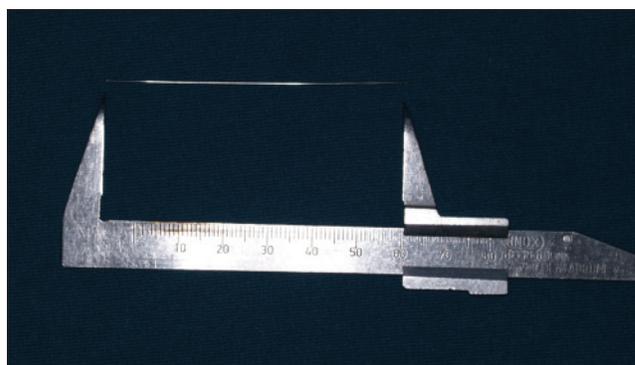


Figure 2a: Segmented orthodontic wire



Figure 2b: Bended wire

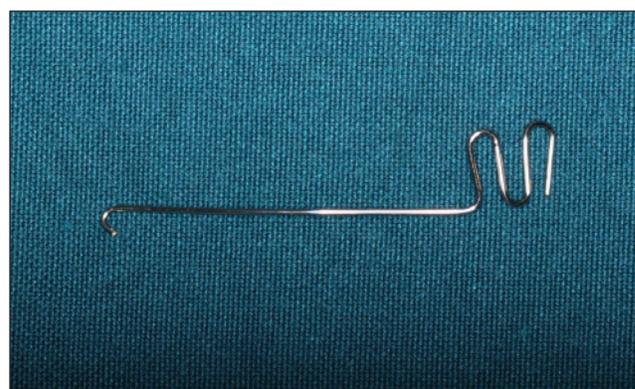


Figure 2c: Fabricated whip spring

treatment, supracrestal fiberotomy was performed and a segmented arch wire was placed to prevent relapse [Figure 1d]. At 1 year follow-up, there were not any pathologic findings in the radiographic view like root resorption [Figure 1e].

Case 2

A 7-year-old boy was referred to the Pediatric Dentistry Department of Mashhad University of Medical Sciences with the chief complaint of severe rotation of the upper anterior tooth. There was no relevant and remarkable medical history reported. The clinical examination showed good facial symmetry and competent lips at rest.

Intraoral examination showed Class II molar relationship with about 90° rotation of left maxillary central incisor. The rotated tooth was not fully erupted [Figure 3a and b]. Class I skeletal pattern with no vertical problems was confirmed by cephalometric analysis and there were no transverse problems. Radiographic examination confirmed severe rotation of left maxillary central incisor and early stage of root development [Figure 3c]. Space

analysis on the study models shows a lack of space in both jaws. At the first visit, an alginate impression was taken from upper arch and a removable appliance consisting of acrylic base plate, circumferential clasps on the maxillary primary canine and Adams clasp on the maxillary permanent premolar and first molars was made. In the later appointment, a bonded mandibular first molar



Figure 3a: Before treatment (frontal view)



Figure 3b: Before treatment (occlusal view)

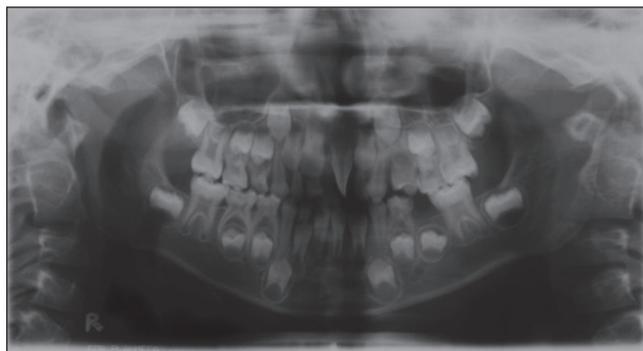


Figure 3c: Initial radiographic view



Figure 3d: 5 month after starting treatment



Figure 3e: Retention phase



Figure 3f: Follow-up radiographic view

buccal tube (Dentaurum, Germany) was placed on the labial surface of the rotated central incisor. Whip spring was constructed with a segment of 0.4 mm stainless steel orthodontic wire (0.0016 inches) (Dentaurum, Germany) ligated into place. In order to protect buccal mucosa and gingiva from irritation the patient was instructed to wear the appliance fulltime and only to remove the appliance for tooth brushing after eating.

In every follow-up appointment, with a month interval, a new whip spring was fabricated. After 5 times replacement of the spring, rotation was almost corrected [Figure 3d]. At the end of treatment, supracrestal fiberotomy was performed and alginate impression was taken of the upper jaw in order to construct a removable appliance for retention. This appliance was made of acrylic base plate, labial bow on anterior segment and Adams clasp on the maxillary permanent first molars [Figure 3e]. There were no pathologic findings in the radiographic view [Figure 3f].

Case 3

A 9-year-old boy was referred to Orthodontics Department of Mashhad University of Medical Sciences. His chief complaint was severe rotation

of his left maxillary central incisor. The patient was medically healthy. His dentistry history revealed that he had a supernumerary tooth between two maxillary central incisors and the mesiodens had been extracted before referring to orthodontic department. Before beginning of treatment, the patient was instructed about oral hygiene. Intraoral examination revealed that the tooth had 90° rotation. Radiographic examination showed early stage of root development [Figure 4a-c] and there was enough space in the upper arch to derotate it. At first alginate impression was taken of the upper jaw and a removable acrylic appliance with C clasps on the maxillary primary canines and Adams clasps on the maxillary permanent first molars was constructed. In the second appointment, just like the previous cases, buccal tube was bonded and the whip spring was constructed and inserted into its position. The patient was instructed to wear the appliance all the time except brushing and eating periods. After 1 month, the tooth was derotated well [Figure 4d]. In this appointment, a new spring was fabricated and this process was repeated 2 times with 1 month interval



Figure 4a: Before treatment (frontal view)



Figure 4c: Initial radiographic view



Figure 4b: Before treatment (occlusal view)

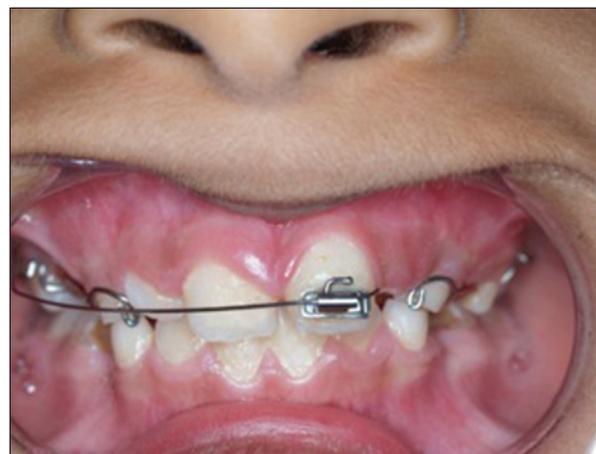


Figure 4d: 1 month after starting treatment

and rotation was corrected. To over-correct the tooth position, the appliance was used one extra month. At the end of treatment, the removable retainer appliance was constructed and used by patient for 6 months to maintain the corrected tooth position [Figure 4e]. Follow-up panoramic radiograph revealed healthy root development [Figure 4f].

DISCUSSION

Tooth rotation, is defined as observable mesiolingual or distolingual intra-alveolar displacement of the tooth around its longitudinal axis.

Relatively few studies on tooth rotation mention the amount or the direction of the rotations.^[3]

Gupta *et al.* classified the rotation into three groups: $<45^\circ$, $45-90^\circ$ and $>90^\circ$. In his study, rotations were the most common (10.24%) anomaly among the whole study group, that the majority of tooth rotations were between 45° and 90° , followed by $<45^\circ$ rotations. The most common rotated teeth were the mandibular second premolars followed by mandibular first premolars and maxillary central incisors with the same prevalence.^[1]

In the present study, three cases with severe rotations of maxillary incisor were treated by whip appliance. The conventional treatment for teeth rotations is a fixed appliance, which in the mixed dentition, this appliance is formed in 2×4 or 2×6 arrangement.^[10] Although this method can correct all kind of rotations, but use of it has some problems. When fixed appliance anchor only to a few teeth instead of all the permanent dentition, the arch wire length is elongated and therefore a large moment can be produced with less strength and a more springy wire. In this situation, the possibility of breaking, distortion and displacement

of the wire is increased. Hence, despite the fact that fixed appliances seem simple, use of them in the mixed dentition has a lot of complexity. Another limitation of the use of fixed appliance in mixed dentition is about anchorage control. Because only first permanent molar can be used to provide posterior anchorage, only limited movement can be carried out.^[10] Furthermore, these appliances could be used only after complete eruption of at least permanent first molars and incisors while in some situation like the first case in this study, emergency correction of rotated tooth is necessary. Another disadvantage of the fixed appliance is difficulty in the oral hygiene that can lead to decalcification of banded and bonded teeth.^[11]

The second alternative for correction of tooth rotation in some particular situations is a removable appliance with a labial bow and a palatal spring like z-spring, which provides the moment to derotate the tooth. In this appliance, the reactive forces are less, therefore there is no particular problem in anchorage. In addition, if the palatal surface of the rotated tooth is positioned along the dental arch, a removable appliance with labial bow and base plate can be used and the contact of tooth with acrylic base plate as the second moment is adequate.^[9] One of the limitations of this method is that only in the case of maxillary central incisor may be indicated and probably can only correct mild rotations less than 45° . This method is unable to correct the rotation of another teeth, severe rotations and multiple teeth rotations. Furthermore, rotations have very high risk of relapse and because patient compliance is needed in the removable appliance, relapse even in the treatment phase is more likely. Another disadvantage of this appliance is its need



Figure 4e: Retention phase



Figure 4f: Follow-up radiographic view

for accurate adjustment of the labial bow, palatal spring and acrylic of the base plate.

Because of the limitations of discussed methods, in this study, we introduced a removable appliance with fixed attachment for treatment of the incisor rotation. We were able to correct 90° and lesser rotations (the majority of teeth rotations are in this range) with this method. In this appliance, a force couple to rotate a tooth can be applied by a whip spring. This force does not have harmful side-effects on tooth development. Mavragani *et al.* suggested that since root shortening due to apical resorption is one of the most serious side-effects of orthodontic treatment, it appears advisable to initiate orthodontic correction of the incisors at a young age during mixed dentition, in an introductory phase of treatment.^[12] Before derotation is undertaken, it is important that sufficient space is available to accommodate the tooth in alignment.^[13] Whip appliance has several advantages for use in the mixed dentition as follows:

1. This appliance solves the problem in the mixed dentition, relatively in a short duration.
2. It can provide increased vertical and horizontal anchorage due to palatal coverage.^[14]
3. Management of anchorage is less critical.^[8]
4. Force system is relatively simple.
5. It is removable and therefore easier to clean.
6. Patient cooperation is less critical, because when removing the appliance, the damage of mucosa by wire leads to patient discomfort.^[8]
7. It can be used in emergency situations in the mixed dentition period such as traumatic occlusion of central incisors.

One of the problems with the use of this appliance is that much attention should be considered not to inadvertently activate the whip in the vertical plane, otherwise unwanted mesiodistal crown and root movement may be produced.^[13] Furthermore, the whip spring can wound the mucosa if not adjusted carefully.

It is implied that rotations are easy to treat, but very difficult to retain. They have a very high risk of relapse due to stretching of the supra-alveolar and transseptal gingival fibers, which readapt very slowly to the new position. Thus, it should be overcorrected if possible and long term retention is required to achieve the stability of treatment.

CONCLUSION

This study, with report of three cases, shows that in some cases such as in the mixed dentition before the eruption of maxillary lateral incisors, which the use of fixed 2 × 4 appliances is impossible or in emergency situations like traumatic occlusion, severely rotated maxillary central incisors can be corrected with whip appliance.

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